

TECHNOLOGY TRANSFER & INNOVATION HANDBOOK

Legal Foundations,
Impact Measurement and
Startup Creation

WORK PACKAGE 4 (WP4)
CAPACITY BUILDING TRAINING AND
KNOWLEDGE TRANSFER



Co-funded by
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TECH2LINK

TECHNOLOGY TRANSFER & INNOVATION HANDBOOK

Legal Foundations, Impact Measurement and Startup Creation

Project	Tech2Link
Format	Self-paced professional development through LMS/Moodle
Structure	3 courses × 3 lessons + practical assignment
Version	Handbook – September 2026

Professional Development Handbook

Preface

The transformation of research and knowledge into practical solutions is one of the most important challenges facing universities and innovation ecosystems today. Scientific discoveries and technological developments can generate significant economic and societal value, but this value is realized only when knowledge can move effectively from research environments toward industry, entrepreneurship, public services and society.

The **Tech2Link Technology Transfer & Innovation Handbook** has been developed in response to this need. It brings together the learning materials developed within the Tech2Link project and presents them as an integrated, learner-oriented resource for technology-transfer professionals, researchers, innovation-support staff, entrepreneurs and other stakeholders involved in the development and commercialization of knowledge and innovation. The handbook is part of **Work Package 4 (WP4) – Capacity Building Training and Knowledge Transfer**.

The underlying vision of Tech2Link is to contribute to a dynamic and sustainable ecosystem in which universities, industry, investors, governments, Technology Transfer Offices, startups and other innovation-support organizations can work together more effectively. The project recognizes that technology transfer is not simply a legal or technical process. It is an ecosystem activity that requires appropriate intellectual-property protection, effective collaboration, sound contractual arrangements, commercialization strategies, performance measurement and responsible decision-making.

This handbook therefore takes an integrated approach to technology transfer. Its three courses are designed as a connected learning pathway. The first establishes the foundations of intellectual property and innovation ecosystems. The second introduces the measurement of technology-transfer performance, economic impact, KPIs and evaluation. The third connects these foundations with commercialization, licensing, negotiation, startup creation and the movement of technologies from research toward the market.

A central principle of the handbook is that **technology transfer should be understood not only as the movement of technology, but as the creation of measurable value**. This value may be financial, economic, institutional or societal. Consequently, learners are encouraged to look beyond individual transactions and consider the wider innovation ecosystem, the relationships among its actors, and the long-term impact of research commercialization. The handbook emphasizes that universities, Technology Transfer Offices, industry, investors, government and support organizations are interconnected participants in this process.

The learning approach is deliberately practical. Rather than focusing exclusively on terminology and theory, the courses ask learners to interpret technology-transfer situations, identify risks, select meaningful indicators, evaluate commercialization alternatives and communicate recommendations. Reflection questions, practical assignments, case studies and applied exercises are used to connect conceptual knowledge with professional decision-making.

The handbook also recognizes that successful commercialization must be responsible commercialization. Intellectual-property protection, contractual and regulatory compliance, data protection, ethics, sustainability, inclusion and responsible innovation are treated as important components of technology-transfer practice. In this context, commercialization is not presented as an end in itself, but as one possible pathway through which knowledge and research can generate meaningful benefits for society.

The practical orientation of the handbook is particularly important for emerging technology-transfer ecosystems. Institutions may differ in their resources, structures, maturity and experience, but

many face common challenges: limited funding, long commercialization timelines, regulatory complexity, insufficient industry engagement and the need to strengthen commercialization expertise. The Tech2Link learning pathway is intended to help address these challenges by developing capabilities that can be applied within universities, Technology Transfer Offices, innovation hubs and related organizations.

The expected outcome is not simply that learners complete a course. Rather, learners should develop the ability to **protect innovation strategically, understand and work within innovation ecosystems, measure what matters, evaluate economic and societal value, manage legal and contractual risks, select appropriate commercialization pathways and communicate strategic recommendations**. These capabilities provide a foundation for stronger university–industry collaboration and more effective innovation support.

The handbook should therefore be viewed as both a learning resource and a practical reference. It can support structured study through the LMS, professional development activities, institutional discussions and the analysis of real or hypothetical technologies. Its purpose is to help bridge the gap between knowledge and action between research capability and practical application, between university innovation and market opportunity, and between technological development and measurable societal impact.

Ultimately, the success of technology transfer is measured not only by the number of patents, licenses, startups or agreements produced, but by the extent to which knowledge and innovation contribute to meaningful outcomes. The Tech2Link Handbook seeks to support the people and institutions responsible for making that connection possible.

We hope this handbook will serve as a useful guide, a practical reference and a starting point for continued learning, collaboration and innovation across the Western Balkans and beyond.

Lejla Abazi-Bexheti

SEEU - Institutional Coordinator

Work Package 4 – Capacity Building Training and Knowledge Transfer

September 2026

Editors

This handbook consolidates the instructional materials developed for the Tech2Link LMS courses into a single learner-oriented reference document. The handbook is intended to support course delivery, self-paced learning, practical application and subsequent use of the materials by technology-transfer professionals, researchers, innovation-support staff and other stakeholders.

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Editorial note: Where the original course materials contain course-specific examples, tools or activities, this handbook summarizes and organizes them rather than reproducing the LMS lessons verbatim. The handbook should therefore be used together with the full LMS materials when detailed study is required.



About the handbook

BRIDGING THE GAP: TECHNOLOGY TRANSFER HUBS CONNECTING WESTERN BALKANS UNIVERSITIES, BUSINESS AND SOCIETY

Tech2Link project is to create a dynamic and sustainable ecosystem that facilitates the transfer of technology, knowledge and innovation between academia and industry, thus driving the economic development by leveraging the intellectual property and research capabilities of higher education institutions in WBs region. The project on the creation of technology transfer hubs in higher education institutions can contribute to the development of a vibrant innovation ecosystem, foster collaboration between academia and industry, and drive economic growth in the region. The Tech2Link consortium is composed of six institutions from both the Western Balkans and the European Union, each contributing specific expertise and responsibilities aligned with their institutional capacities and the objectives of the project. The responsibilities are distributed to ensure effective implementation of all work packages, with a clear allocation of tasks supporting both technical and administrative dimensions.

PROJECT CONSORTIUM

- Western Balkans University (WBU), Albania
- Luarasi University (LU), Albania
- University of Pristina (UP), Kosovo
- International Business College Mitrovica (IBC-M), Kosovo
- South East European University (SEEU), North Macedonia
- Lodz University of Technology (LUT), Poland

Work Package 4 (WP4) – Capacity Building Training and Knowledge Transfer.

Tech2Link LMS Website (<https://tech2link.org/>)

Tech2Link LMS Platform (<https://tech2linklms.cloud/>)

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**Co-funded by
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About the publisher

The textbook was prepared in the scope of the project:

**"BRIDGING THE GAP: TECHNOLOGY TRANSFER HUBS CONNECTING WESTERN
BALKANS UNIVERSITIES, BUSINESS AND SOCIETY"**

Published by:

SOUTH EAST EUROPEAN UNIVERSITY, TETOVO

Editor: Burim Ismaili

Printed by: Professional Print, Tetovo

Distribution: **50** copies

Printed in Republic of North Macedonia

First Printing Edition, September 2026

ISBN 978-608-248-072-5

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The European Commission's support for the production of this publication does not constitute an endorsement of the contents, which reflect the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

CIP - Каталогизација во публикација

Национална и универзитетска библиотека "Св. Климент Охридски", Скопје

005.94:[001.92+001.894](035)

HALILI, Albana

Technology transfer & innovation handbook : legal foundations,
impact measurement and startup creation : professional development
handbook / [authors Albana Halili, Lejla Abazi Bexheti, Arbana Kadriu].

- Tetovë : Universiteti i Evropës Juglindore, 2026. - 242 стр. : илустр.
; 30 см

Библиографија: стр. 237-240. - Содржи и: Appendix

ISBN 978-608-248-072-5

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Прирачници

COBISS.MK-ID 69764869

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Introduction

Bridging Research, Innovation and Society

Technology transfer has become an increasingly important mechanism through which universities and research institutions contribute to economic development, industrial competitiveness and societal progress. Research generates new knowledge, inventions and technological solutions, but research excellence alone does not guarantee that these results will reach the people, organizations and markets that can use them.

Technology transfer is the process through which knowledge, research results, inventions and technologies move from research environments toward practical use, commercial application and societal impact. This process can involve intellectual-property protection, licensing, collaborative research, startup creation, industry partnerships, investment, regulatory approval and the development of new products and services. Effective technology transfer therefore requires the coordinated contribution of researchers, universities, Technology Transfer Offices (TTOs), companies, investors, governments and innovation-support organizations.

The **Tech2Link Technology Transfer & Innovation Handbook** has been developed to support this process by bringing together three complementary areas of capability: **legal and intellectual-property foundations, measurement and economic impact, and commercialization and startup development.**

The handbook is particularly relevant to the development of technology-transfer capacity within the Western Balkans, where stronger connections between universities, business, government and society can contribute to the development of sustainable innovation ecosystems. The Tech2Link project brings together institutions from Albania, Kosovo, North Macedonia and Poland, with the objective of strengthening collaboration, knowledge transfer and innovation capacity.

The Technology Transfer Challenge

The journey from research discovery to societal or commercial impact is rarely linear. A promising research result may require intellectual-property protection before it can be publicly disclosed. It may then require additional technical development, market validation, funding, regulatory approval, an industrial partner or the creation of a new company.

At each stage, different questions arise:

- What intellectual property has been created?
- Who owns the research result?
- How should the innovation be protected?
- Is there relevant prior art?
- Can the technology be commercialized without infringing third-party rights?
- Which commercialization pathway is most appropriate?
- How should technology-transfer performance be measured?
- What economic and societal value has been created?
- What contractual and regulatory risks need to be managed?
- Should the technology be licensed, developed through a partnership or commercialized through a startup?
- How can innovation be developed responsibly, sustainably and inclusively?

The handbook addresses these questions progressively. It recognizes that technology transfer is more than the management of patents or the signing of licensing agreements. It is an integrated

process that combines knowledge, intellectual property, people, institutions, finance, markets, legal frameworks and relationships.

From Knowledge to Value

A central principle of the Tech2Link learning pathway is that successful technology transfer should ultimately create value.

That value can take many forms. It may include licensing revenues and investment returns, but it may also involve new companies, employment, industrial competitiveness, improved public services, environmental benefits, better healthcare, new research partnerships and broader societal impact.

This is why measurement is an essential component of technology transfer. The handbook emphasizes that good measurement is not simply about collecting a large number of indicators. Indicators should be precise, relevant to decisions and aligned with the purpose of technology transfer. The measurement framework therefore considers institutional performance, economic value, commercialization outcomes and social return.

The same principle applies to commercialization. A patent, license or startup is not automatically a successful outcome. The effectiveness of a technology-transfer activity depends on whether it creates meaningful and sustainable value for the relevant stakeholders.

Technology Transfer as an Innovation Ecosystem

Technology transfer takes place within an ecosystem rather than in isolation.

Universities generate knowledge and research. Researchers contribute expertise and inventions. Technology Transfer Offices identify and protect promising intellectual property and help establish commercialization pathways. Industry partners contribute market knowledge, manufacturing capabilities, customers and commercialization expertise. Investors provide financial resources. Governments establish policies, regulation and funding mechanisms. Incubators, accelerators and innovation hubs provide infrastructure, mentoring, networks and entrepreneurial support.

The handbook therefore places considerable emphasis on the relationships among these actors. Innovation ecosystems connect scientific knowledge, entrepreneurship, investment, policy and industry in order to transform ideas into products, services and societal solutions.

This ecosystem perspective is particularly important for universities. Modern universities increasingly have responsibilities that extend beyond teaching and research. They are also expected to contribute to entrepreneurship, regional development, industrial collaboration and the commercialization of research results.

Technology Transfer Offices are an important mechanism for achieving this connection. Their activities can include invention identification, patent assessment and filing, technology valuation, licensing negotiations, startup and spin-off support, industry partnership development and commercialization strategy.

A Connected Learning Pathway

The Tech2Link handbook is organized as a **three-stage learning pathway**. Each course addresses a different question, while together they provide a broader understanding of technology transfer.

Stage	Course	Central Question
1	Legal and Intellectual Property Foundations of Technology Transfer	What is being protected and who supports innovation?
2	Measuring Technology Transfer Success: Economic Impact, KPIs and Evaluation	How do we know whether transfer creates value?
3	Startup Creation through TT Hubs: From Research Idea to Market	How can startup creation be structured safely and commercially?

The three stages are deliberately connected. The first establishes the legal and intellectual-property foundations. The second develops the ability to measure performance and understand economic and societal value. The third brings these capabilities into commercialization and startup development.

This structure allows learners to move from **understanding**, to **measuring**, and finally to **acting and commercializing**.

Course I: Legal and Intellectual Property Foundations

The first course establishes the foundations required to understand and manage intellectual property and technology-transfer relationships.

It introduces patents, copyright, trademarks, trade secrets and know-how, while also examining innovation ecosystems, patentability, prior art and Freedom-to-Operate. It considers how universities manage intellectual property, how Technology Transfer Offices support commercialization and how legal and ethical considerations influence innovation.

The course also examines contractual instruments such as Non-Disclosure Agreements, Material Transfer Agreements and Joint Development Agreements, as well as ownership models and legal risk management.

The purpose is not simply to teach legal terminology. Learners are expected to understand how intellectual-property and contractual decisions influence commercialization and university–industry collaboration.

Course II: Measuring Technology Transfer Success

The second course moves from legal foundations to performance and value.

Technology transfer requires evidence-based management. Institutions need to understand whether their activities are producing meaningful results and whether resources are being used effectively.

The course therefore introduces technology-transfer metrics, institutional and economic KPIs, the Triple Helix model, commercialization-pipeline measurement, Social Return on Investment (SROI), benchmarking and innovation-ecosystem assessment. It also addresses the risks of measurement gaming and emphasizes that indicators should support decision-making rather than simply increase reporting volume.

This perspective is important because technology-transfer success cannot be reduced to a single number. Financial returns, patents, licenses, startups, partnerships, investment, employment and societal outcomes may all provide different perspectives on performance.

Course III: Startup Creation and Commercialization

The third course focuses on the movement from research idea toward market application and startup creation.

It addresses ideation, problem–solution alignment, incubation, Minimum Viable Products, investor readiness, market strategy, growth planning and the broader support provided by technology-transfer hubs. Commercialization may take different forms. A university may license a technology to an established company, establish a strategic partnership, create a joint venture or support the formation of a startup or spin-off. The appropriate choice depends on the technology, market, resources, development requirements, investment needs and long-term objectives. The handbook consequently presents commercialization as a **strategic decision**, rather than a single predefined process.

Learning Philosophy

The Tech2Link courses combine conceptual learning with practical decision-making. Learners are not expected merely to memorize concepts. They are encouraged to interpret technology-transfer situations, identify risks, select appropriate indicators, evaluate commercialization alternatives and communicate recommendations.

This philosophy is reflected throughout the handbook through:

- lesson objectives and learning outcomes;
- practical examples and case studies;
- reflection and discussion questions;
- applied learning activities;
- commercialization scenarios;
- practical assignments;
- strategic recommendations and decision-making exercises.

The case studies demonstrate that technology transfer can take many forms, including university spin-offs, patent licensing, public–private partnerships, collaborative R&D and international technology diffusion.

Responsible Innovation

Technology transfer must also consider the wider consequences of innovation.

The handbook addresses ethical issues including data privacy, AI bias, biotechnology risks, unequal access to technology, environmental impact and conflicts of interest. It emphasizes responsible innovation, sustainability, transparency and accountability alongside commercial objectives.

This approach recognizes that a technology may be technically feasible and legally protectable while still raising important ethical or societal questions. Responsible commercialization therefore requires consideration of not only **whether a technology can be commercialized, but also how and under what conditions**.

How to Use This Handbook

The handbook is designed to complement the Tech2Link LMS rather than replace it. The original materials include course pages, activities and learning resources, while this handbook provides an integrated reference that brings the learning pathway together.

Learners are encouraged to:

Study the courses sequentially, allowing the concepts from one stage to support the next.

Use the reflection questions to relate the material to their own institution, research environment or professional context.

Work through the practical activities rather than relying exclusively on theoretical reading.

Analyze the case studies to understand how technology transfer operates in different sectors and environments.

Complete the practical assignment at the end of each chapter.

Use the handbook as a reference when developing IP strategies, KPI frameworks, commercialization plans, risk assessments or startup strategies.

Return to the LMS materials when additional explanations, activities or detailed learning resources are required.

From Learning to Professional Capability

The ultimate objective of the handbook is capability development.

After completing the three-course pathway, learners should be able to demonstrate capabilities in intellectual-property and ecosystem literacy, performance measurement, economic evaluation, legal awareness, commercialization planning and strategic communication. These capabilities can be applied in research and innovation support, TTO and innovation-hub management, investment and commercialization decisions, university–industry collaboration, licensing, partnerships and spin-off development.

The practical assignments reinforce this objective. For example, the handbook's Smart-Heal AI scenario requires learners to consider IP protection, ownership, commercialization pathways, legal and regulatory risks, funding, ecosystem support and ethical implications as interconnected decisions rather than separate issues.

The Broader Purpose

The Tech2Link Handbook ultimately seeks to contribute to a stronger culture of innovation and technology transfer.

Its central message is simple:

Research creates knowledge. Technology transfer connects that knowledge with use. Innovation ecosystems create the conditions for that connection. Measurement demonstrates the value created. Responsible commercialization helps ensure that value is sustainable and beneficial to society.

In this sense, technology transfer is not the final stage of research. It is a continuing process of connecting **people, knowledge, intellectual property, institutions, markets and society**.

The three courses in this handbook provide a structured pathway through that process from protecting innovation, to measuring its value, to developing practical routes toward commercialization and startup creation. Together, they are designed to help learners move beyond understanding technology transfer as a concept and toward applying it as a professional capability.

The ultimate goal is to strengthen the bridge between **Western Balkans universities, business and society** and to support innovation that can generate economic opportunity, institutional development and meaningful societal impact.

Chapter I: Legal and Intellectual Property Foundations of Technology Transfer

Course overview

This course develops the legal and commercial awareness needed to structure technology-transfer relationships. It covers IP ownership, contracts, legal risk, international frameworks, licensing, negotiation, freedom-to-operate and startup development.

Innovation and scientific discovery create enormous social and economic value. However, without proper intellectual property management and commercialization mechanisms, many valuable research results never reach society or the market. This lesson introduces the foundations of intellectual property (IP), innovation ecosystems, and the institutional structures that support knowledge commercialization.

Course learning outcomes

After completing this lesson, learners will be able to:

- Define intellectual property and explain its role in innovation.
- Distinguish between patents, copyrights, trademarks, and trade secrets.
- Explain the concept of innovation ecosystems.
- Identify patentability criteria and understand prior art.
- Describe the role of universities and Technology Transfer Offices.
- Recognize ethical and legal considerations in innovation.

Recommended LMS learning flow

- Establish the legal foundation and ownership logic.
- Study contractual instruments and compliance.
- Apply licensing, negotiation and FTO concepts to commercialization decisions.
- Complete the practical agreement-and-commercialization exercise.

Lesson 1: Legal Foundations for Technology Transfer

Lesson overview. This section establishes the legal foundations required before entering technology-transfer relationships. It links intellectual-property ownership, institutional policies, confidentiality, publication and commercialization rights.

Learning outcomes

- Explain the relationship between IP ownership and commercialization rights.
- Identify ownership issues in employee, student and collaborative inventions.
- Recognize the importance of confidentiality and publication management.
- Explain why institutional IP policies are necessary.
- Identify issues that should be resolved before a collaboration begins.

Core topics

- University, joint and industry ownership
- Employee and student inventions

- Background and foreground IP
- Publication rights and academic freedom
- Confidential information
- Revenue sharing
- Commercialization responsibilities
- Conflict-of-interest considerations

Learning activity / reflection

Review a hypothetical university–industry collaboration and list the ownership, publication, confidentiality and commercialization questions that should be resolved before work begins.

Lesson summary

Clear ownership and governance arrangements reduce disputes and create a stronger foundation for research collaboration and commercialization.

1: Introduction to Intellectual Property

Understanding of intellectual property

Intellectual Property (IP) refers to creations of the human mind that can be legally protected and commercially exploited. These creations may result from scientific research, technological innovation, artistic creativity, software development, engineering activities, or business processes. Examples: inventions, software, algorithms, scientific discoveries, industrial designs, artistic works, trademarks and brands, confidential business information, databases, manufacturing processes, technological know-how.

Unlike physical assets such as buildings or machinery, intellectual property is an intangible asset. Intangible assets may include: patents, software code, trade secrets, data, reputation, customer relationships, research expertise.

For many modern technology companies, intangible assets represent the majority of organizational value. Examples: technology companies rely heavily on software and algorithms; pharmaceutical companies depend on patents; luxury brands depend on trademarks and reputation; AI startups depend on proprietary data and machine-learning models. In many cases, investors value intellectual property more highly than physical infrastructure.

Modern international IP systems

Today, intellectual property is regulated through both national laws and international agreements. Important international organizations and frameworks include:

- the World Intellectual Property Organization (WIPO),
- the European Patent Office (EPO),
- the WTO TRIPS Agreement,
- national patent offices.

Globalization and digital technologies continue to transform the intellectual property landscape.

Why intellectual property matters?

Intellectual property rights provide creators and institutions with legal mechanisms of:

1. Protecting innovation

IP protection prevents unauthorized copying and imitation. Without protection, innovators may lose the incentive to invest time and resources in research and development.

2. Securing competitive advantage

Protected technologies and brands help organizations differentiate themselves in the market.

For example: patents protect technological uniqueness; trademarks protect brand identity; trade secrets protect confidential business knowledge.

3. Attracting investment

Investors often evaluate whether a company owns valuable intellectual property before providing funding. Strong IP portfolios may indicate innovation capacity, market exclusivity, growth potential, long-term strategic value.

4. Supporting commercialization

IP rights enable organizations to license technologies, create startups, establish partnerships, negotiate commercialization agreements.

5. Encouraging Further Research and Development

By providing temporary exclusivity, intellectual property systems encourage organizations to invest in innovation. This contributes to scientific progress, technological development, economic competitiveness.

Strategic approaches to intellectual property

Organizations use different IP strategies depending on their goals.

- **Defensive Strategy** - Organizations protect inventions primarily to prevent competitors from copying technologies.
- **Offensive Strategy** - Companies actively use patents and trademarks to strengthen market position and negotiate licensing revenues.
- **Open Innovation Strategy** - Some organizations selectively share intellectual property to encourage collaboration and ecosystem growth.
- **Trade Secret Strategy** - In some industries, organizations prefer secrecy instead of patent disclosure.

Choosing the appropriate strategy depends on:

- industry dynamics,
- commercialization plans,
- competitive environment,
- regulatory considerations.

Reflection questions

1. Why might startups with patents attract more investment?
2. Should all scientific discoveries be patented?
3. What are the risks of sharing innovation without legal protection?
4. Can intellectual property sometimes limit access to important technologies?

2. Types of Intellectual Property

Main categories of intellectual property

Intellectual property protection includes several legal mechanisms designed to protect different types of innovation, creativity, and commercial identity. Choosing the correct form of protection is critical because different IP rights protect different aspects of knowledge and innovation.

Organizations often combine multiple forms of intellectual property protection within a single commercialization strategy. For example, a technology startup may simultaneously use:

- patents to protect inventions,
- copyright to protect software,
- trademarks to protect branding,
- trade secrets to protect confidential know-how.

Patents

A patent is an exclusive legal right granted for a technical invention. Patents allow inventors to prevent others from making, using, selling, importing, commercializing an invention without permission. Patent protection is territorial, meaning patents are granted separately in different countries or regions.

Patent systems aim to encourage innovation, stimulate investment in research and development, promote public disclosure of technological knowledge. In exchange for temporary exclusivity, inventors must publicly disclose how the invention works.

Duration of patent protection

Patent protection generally lasts 20 years from the filing date. However, maintaining protection usually requires payment of annual maintenance fees. After expiration, the invention enters the public domain and may be freely used by others.

Examples of Patentable Technologies:

Medical Technologies

- diagnostic devices,

- surgical instruments,
- pharmaceutical compounds,
- biotechnology inventions.

Artificial Intelligence

- AI-based diagnostic systems,
- machine-learning optimization methods,
- industrial automation systems.

Engineering Solutions

- manufacturing technologies,
- robotics systems,
- renewable energy devices,
- smart materials.

Advantages and disadvantages of patents

Patents may create market exclusivity, attract investors, increase company valuation, generate licensing revenues, strengthen competitive position.

Patents also have disadvantages: disclosure of technical information, high filing and maintenance costs, lengthy application procedures, territorial limitations, not all technologies are suitable for patent protection.

Copyright

Copyright protects original creative works. Unlike patents, copyright does not protect ideas themselves but rather the specific expression of those ideas. Copyright protection arises automatically upon creation and usually does not require registration.

Types of works protected by copyright

Software and digital content

- software code,
- websites,
- mobile applications,
- databases.

Scientific and educational works

- scientific publications,
- books,
- educational materials,
- presentations.

Multimedia and artistic works

- videos,
- music,

- photographs,
- graphic design,
- films.

Copyright rights

Copyright generally includes:

- economic rights - allow creators to: reproduce works, distribute copies, license content, generate commercial revenues.
- moral rights – protect authorship, integrity of the work, attribution. These rights are often non-transferable.

Copyright and software

Software is one of the most commercially important copyright-protected assets. However, software-related innovation may sometimes also involve: patents, trade secrets, licensing agreements. Modern software businesses often combine multiple IP strategies.

Duration of copyright

In many jurisdictions, copyright protection lasts for the life of the author plus 70 years. The duration may vary depending on national law.

Trademarks

A trademark distinguishes products or services in the marketplace. Trademarks help consumers identify the origin of products, brand reputation, quality expectations. Strong trademarks are extremely valuable business assets.

Examples of trademarks:

Brand elements

- company names,
- logos,
- slogans,
- product names,
- symbols,
- packaging design.

Examples of globally recognized trademarks include: Apple, Coca-Cola, Nike, Google.

Functions of trademarks

Trademarks support brand recognition, customer trust, market differentiation, consumer loyalty. They are especially important in highly competitive markets.

Trademark protection

Trademark owners can prevent others from using confusingly similar signs. Protection may continue indefinitely if trademarks remain in use, renewal fees are paid.

Trademark strategy in startups

For startups, trademarks are important because they build brand identity, support marketing, increase company valuation and improve investor confidence. A strong brand may eventually become more valuable than the technology itself.

Trade Secrets and Know-How

Trade secrets protect confidential business information with commercial value. Unlike patents, trade secrets are not publicly disclosed. Protection depends on maintaining secrecy.

Examples of trade secrets

Technical information

- manufacturing formulas (for example the most famous one: Coca-Cola formula)
- algorithms,
- source code,
- industrial processes.

Business Information

- customer databases,
- pricing strategies,
- marketing plans,
- supplier relationships.

Requirements for trade secret protection

Information must have commercial value, not be publicly known and be protected through reasonable confidentiality measures. Organizations often use: NDAs, cybersecurity systems, restricted access or employee confidentiality clauses.

Advantages and disadvantages of trade secrets:

Trade secrets do not require registration, may last indefinitely, avoid public disclosure. This strategy is particularly useful when reverse engineering is difficult.

Trade secrets may be lost through leaks, cyberattacks, employee misconduct, reverse engineering. Once confidentiality is lost, protection may disappear permanently.

Combining different forms of IP protection

Modern technologies are often protected through multiple overlapping mechanisms (for example: smartphone – may involve patents protecting hardware innovations, copyright protecting software, trademarks protecting brand identity, trade secrets protecting manufacturing processes. Integrated IP strategies are common in modern technology industries.

Choosing the right IP strategy, organizations must decide: what should be patented, what should remain confidential, what should be licensed, what should be openly shared.

Factors influencing strategy include: industry sector, commercialization goals, development costs, market competition, speed of innovation.

Reflection questions

1. Why might some companies prefer trade secrets over patents?
2. Should software always be patentable?
3. How do trademarks influence consumer trust?
4. What are the risks of relying only on one type of IP protection?

3. Innovation Ecosystems

An innovation ecosystem is a dynamic network of organizations, institutions, individuals, and supporting mechanisms that interact to create, develop, finance, regulate, and commercialize innovation. Innovation ecosystems connect scientific knowledge, entrepreneurship, investment, policy, and industry to transform ideas into products, services, and societal solutions. Innovation ecosystems emphasize: collaboration, knowledge exchange, interdisciplinary, co-creation, continuous interaction between stakeholders. Innovation ecosystems operate at different levels: local, regional, national, international, sector-specific, digital.

Examples: Silicon Valley, biotechnology clusters, university innovation districts, European Digital Innovation Hubs, startup ecosystems.

Key actors in innovation ecosystems

- Universities

Universities are increasingly central actors in innovation ecosystems. In addition to education and research, universities now contribute through technology commercialization, startup creation, patent generation, industry collaboration, regional economic development.

- Research Institutes

Research institutes conduct specialized scientific and technological research. They often focus on: applied research, strategic technologies, national priorities, industrial collaboration. Research institutes may provide: advanced laboratories, technical expertise, pilot testing facilities, interdisciplinary collaboration.

- Startups

Startups play a critical role in transforming innovation into market applications. Unlike large corporations, startups are often agile, experimental, highly innovative, willing to take technological risks. Startups contribute by accelerating technology adoption, attracting investment, creating jobs, introducing disruptive innovation.

- University spin-offs

Many innovation ecosystems support university spin-offs that commercialize academic research. Spin-offs often emerge from: laboratory discoveries, doctoral research, collaborative projects.

- Industry partners

Industry partners help bridge the gap between research and the market. Companies contribute: commercialization expertise, manufacturing capabilities, market access, customer networks, industrial infrastructure.

- Investors

Innovation ecosystems depend heavily on financing. Investors provide resources necessary to transform ideas into scalable businesses. Types of investors: angel investors, venture capital funds, corporate investors, public innovation funds, development banks, crowdfunding platforms. Investors typically assess: market potential, team quality, intellectual property, scalability, technological uniqueness, ESG performance.

- Government agencies

Governments shape innovation ecosystems through regulation, funding, infrastructure, innovation policy and education systems. Governments may support innovation through: research grants, tax incentives, startup funding, innovation clusters, national technology strategies.

- Technology Transfer Offices (TTOs)

Technology Transfer Offices facilitate commercialization of research results by identifying inventions, managing intellectual property, filing patents, negotiating licenses, supporting startup creation, connecting researchers with industry. TTOs act as intermediaries between academia and the market.

- Incubators and accelerators

Incubators and accelerators support early-stage companies. Incubators typically provide: office space, mentorship, networking, training, business support. Accelerators usually focus on rapid startup growth through intensive mentoring, investor access, short-term development programs and market validation.

- Innovation Hubs

Innovation hubs are collaborative environments connecting academia, industry, startups, investors and public institutions. Innovation hubs often focus on development, digital transformation, technology transfer, interdisciplinary innovation.

Example of an innovation ecosystem in action

A university develops a new medical sensor.

Step 1 – Research Discover: Researchers create a prototype capable of monitoring cardiovascular health.

Step 2 – Intellectual Property Protection: The Technology Transfer Office evaluates patentability and files a patent application.

Step 3 – Incubation: An incubator supports: business planning, market analysis, team development, mentoring.

Step 4 – Investment: Angel investors and venture capital funds provide financing for prototype development and clinical testing.

Step 5 – Startup Formation: A university spin-off company is established to commercialize the technology.

Step 6 – Regulatory Approval: The startup obtains medical certifications and regulatory approvals.

Step 7 – Market Adoption: Hospitals and healthcare providers adopt the technology.

Step 8 – Societal Impact: The innovation improves patient outcomes and creates economic value.

This example demonstrates how multiple ecosystem actors interact throughout the innovation lifecycle.

Challenges facing innovation ecosystems

Despite their benefits, innovation ecosystems also face challenges. Common challenges are: fragmented collaboration, insufficient funding, weak industry engagement, bureaucracy, regulatory barriers, unequal access to innovation resources and talent shortages.

Reflection questions

1. Why are universities increasingly expected to support entrepreneurship?
2. Which ecosystem actor is most important for successful commercialization?
3. Can innovation ecosystems function effectively without government support?
4. How does digital transformation influence innovation ecosystems?

4. Patentability and Prior Art

Not every invention can receive patent protection. Patent systems are designed to protect genuine technological innovation rather than abstract ideas or discoveries without practical application. Patentability criteria help ensure that patents are granted only for inventions that contribute meaningful technical advancement. Patent office's evaluate whether an invention satisfies specific legal and technical requirements before granting exclusive rights.

Patentability criteria:

1. Novelty

Novelty means that the invention must be new. Patent systems aim to reward genuinely new technological solutions. If an invention is already publicly known, granting exclusive rights would

not contribute additional value to society. An invention is not considered novel if identical or substantially similar information has already been publicly disclosed anywhere in the world before the patent application filing date. This is often referred to as the “absolute novelty” principle. Public disclosure may include scientific publications, patents, conference presentations, websites, videos, product demonstrations, social media posts, marketing materials, public use of the invention. Even an inventor’s own public disclosure may destroy novelty in many jurisdictions.

Some countries provide a grace period allowing inventors to file a patent after limited public disclosure. For example, the United States offers certain grace-period protections, many European jurisdictions apply stricter novelty rules. Because legal standards differ internationally, inventors must carefully manage publication timing.

2. Inventive step

Inventive step means that the invention must not be obvious to a person skilled in the relevant technical field. The invention should represent a genuine technological advancement rather than a routine modification. Patent examiners compare the invention with existing prior art. They assess whether the invention would have been obvious to: engineers, scientists or technical specialists working in the relevant field.

Examples of potentially non-inventive changes: changing material size without technical improvement, combining well-known technologies in predictable ways, replacing one standard component with another equivalent component.

Examples of inventive solutions: novel AI architectures improving medical diagnostics, new battery technologies significantly extending energy storage, innovative manufacturing methods reducing environmental impact.

Without the inventive-step requirement, patent systems could become overloaded with trivial modifications. The requirement ensures that patents reward meaningful innovation rather than routine development.

3. Industrial Applicability

The invention must be capable of practical use. It must function in at least one area of industry, commerce, agriculture, healthcare, or technology.

Examples of industrially applicable inventions: medical devices, renewable energy systems, manufacturing technologies, pharmaceutical compounds, industrial AI systems.

Examples typically not patentable: abstract mathematical theories, purely aesthetic creations, scientific discoveries without application, impossible or non-functional inventions.

Prior art

Prior art refers to all publicly available information related to an invention before a patent application is filed. Prior art establishes the state of existing knowledge in a technical field. Patent examiners use prior art to determine novelty and inventive step.

Prior art may include scientific articles, patents, patent applications, conference presentations, technical reports, websites, videos, theses and dissertations, product manuals, public demonstrations, online repositories, open-source software. The rapid growth of digital information has significantly expanded the amount of accessible prior art.

Freedom to operate (FTO)

Prior-art analysis is closely connected to Freedom-to-operate studies. An FTO analysis evaluates whether commercialization may infringe existing intellectual property rights. FTO studies help organizations: reduce legal risks, attract investors, avoid litigation, support licensing negotiations. Commercial success depends not only on obtaining patents but also on avoiding infringement of others' rights.

Common Patent Databases

1. Google Patents - provides free access to patents, patent applications, legal status information, machine-translated documents. It offers user-friendly search capabilities and AI-supported search functions.
2. Espacenet - operated by the European Patent Office, provides access to over 140 million patent documents worldwide.
3. WIPO Patentscope - supports international patent searches, especially for Patent Cooperation Treaty (PCT) applications.
4. National Patent Office Databases - countries maintain their own patent databases.

Common mistakes made by researchers and startups:

1. premature disclosure - publishing inventions before patent filing may destroy novelty.
2. incomplete searches - limited searches may overlook important patents.
3. ignoring international protection - patent protection is territorial. Protection in one country does not automatically apply globally.
4. assuming scientific publication equals patentability - scientific novelty and patent novelty are not identical concepts. An invention may be scientifically interesting but still fail patentability requirements.
5. strategic importance of patent information - patent documents contain enormous amounts of technical knowledge. Organizations use patent analysis for competitive intelligence, market forecasting, investment planning, R&D strategy, partnership identification. Patent databases are therefore not only legal resources but also strategic innovation intelligence tools.

Reflection questions

1. Why can public disclosure before patent filing be risky?
2. Should AI-generated inventions receive patent protection?
3. How does prior-art analysis support commercialization strategy?
4. Can patent systems sometimes slow innovation?

5. Intellectual Property in Universities

Universities are among the most important generators of new knowledge and innovation. As universities increasingly participate in innovation ecosystems, intellectual property management has become a strategic institutional activity. Modern universities are expected not only to produce research but also to ensure that research outcomes create societal and economic impact. This process is closely connected to technology transfer, commercialization, startup creation and industry collaboration.

IP ownership in academic institutions

Universities commonly establish internal intellectual property regulations to clarify: ownership of inventions, researcher responsibilities, disclosure procedures, commercialization processes, revenue-sharing mechanisms, conflict-of-interest rules.

Clear IP policies help: reduce legal disputes, encourage commercialization, support industry collaboration, protect institutional interests, motivate researchers.

These policies are often defined through university statutes, employment contracts, research agreements, national legislation.

University IP policies typically regulate:

- invention disclosure - researchers are often required to disclose inventions to the university before public disclosure.
- patent filing procedures - policies define who evaluates inventions, who decides whether to file patents, how filing costs are covered.
- commercialization pathways - policies may define licensing procedures, startup creation rules, spin-off policies, collaboration with investors.
- publication rules - policies attempt to balance academic freedom, scientific publication, commercialization requirements.
- conflict-of-interest management - universities establish mechanisms to manage situations where researchers hold financial interests in commercial entities.

Typical ownership rules

1. Employee inventions

Research developed within employment duties is often owned by the university. This applies especially when: university infrastructure is used, research is funded by the institution, the invention relates to assigned duties.

2. Student inventions

Student-created inventions may belong to students unless: contractual agreements specify otherwise, the invention results from sponsored research, university resources play a substantial role.

3. Collaborative Research

Joint projects with industry may create shared ownership, licensing arrangements, negotiated commercialization rights.

Why universities manage intellectual property?

Universities protect intellectual property for several strategic reasons.

1. Supporting societal impact

Universities increasingly aim to ensure that research benefits society. Commercialization may allow innovations to improve healthcare, support sustainability, strengthen digital transformation, increase industrial competitiveness.

Without commercialization pathways, many research results may remain unused.

2. Attracting industrial collaboration

Industry partners often prefer collaborating with universities that manage IP professionally, provide legal certainty, support commercialization, maintain efficient negotiation processes.

Strong IP management increases trust between academia and industry.

3. Generating revenue

Universities may generate revenue through licensing agreements, patent sales, startup equity, collaborative research.

4. Encouraging entrepreneurship

Universities increasingly encourage startup creation, spin-offs, entrepreneurial education, innovation culture.

Revenue Sharing

Commercialization revenues are often distributed between: researchers and inventors, academic departments and TTO's.

Revenue-sharing systems may encourage invention disclosure, strengthen entrepreneurial culture, increase researcher engagement and improve commercialization activity. Researchers are generally more likely to participate actively when they receive financial incentives.

Revenue sharing may also create tensions regarding fairness, inventor contribution, interdisciplinary projects, student participation and institutional priorities.

Disputes may occur when multiple inventors contribute differently, industry partners are involved, ownership is unclear. Transparent institutional policies are therefore essential.

Academic freedom vs commercialization

Universities must balance academic openness, publication culture, and commercialization objectives. Researchers often prioritize publication, scientific recognition and open collaboration. On the other hand, commercialization may require confidentiality, delayed publication, patent filing before disclosure. Successful universities develop systems that support both scientific excellence and innovation commercialization.

Reflection questions:

1. Should universities own inventions created by researchers?
2. How can universities balance open science and commercialization?
3. What are the advantages and disadvantages of university patenting?
4. Should publicly funded research always remain publicly accessible?

5. Technology Transfer Offices (TTOs)

Technology Transfer Offices (TTOs) are specialized university or research institution units responsible for supporting the commercialization of scientific research and innovation. TTOs help transform academic discoveries into practical applications that generate: societal impact, economic value, industrial innovation, startup creation, regional development.

Main Functions of TTOs:

1. IP Identification and Scouting

TTOs help identify promising inventions and research results with commercialization potential.

This process is often called technology scouting or innovation scouting. Potentially commercializable innovations may emerge from: scientific research, doctoral projects, interdisciplinary collaborations, industry-funded research, laboratory discoveries.

TTOs evaluate novelty, market potential, technological maturity, competitive advantage, patentability and scalability.

2. Patent Filing Support

TTOs coordinate intellectual property protection strategies. This may include: prior-art searches, patentability assessments, patent drafting filing national and international patent applications,

managing patent portfolios. TTOs frequently work with patent attorneys, IP law firms, external technical experts.

Because patent protection is expensive, TTOs must decide whether patent filing is justified, in which countries protection should be sought, whether commercialization potential justifies investment.

3. Technology Valuation

Technology valuation estimates the commercial value of intellectual property.

Common Valuation Approaches

- cost-based valuation,
- market-based valuation,
- income-based valuation,
- discounted cash-flow analysis.

Challenges in Valuation:

Early-stage technologies are often difficult to value because markets may not yet exist, technical risks remain high, commercialization timelines are uncertain.

4. Licensing negotiations

Licensing allows companies to use university technologies under agreed conditions. TTOs negotiate agreements covering: exclusivity, royalties, milestone payments, sublicensing rights, territorial scope, performance obligations.

Negotiation challenges:

TTOs must balance university interests, researcher expectations, company profitability, long-term partnership goals.

5. Startup and spin-off support

Many universities encourage researchers to create startups and spin-offs. TTOs may support: business planning, team building, investor introductions, IP licensing, regulatory guidance, commercialization strategy.

6. Industry partnership development

TTOs help establish partnerships between universities and industry. Industry collaboration may involve: sponsored research, joint development projects, contract research, collaborative laboratories or student internships. Partnerships may provide funding, market access, industrial expertise, commercialization pathways, employment opportunities for graduates.

7. Commercialization strategy development

TTOs help determine the most appropriate pathway for bringing technology to market. Options may include: licensing, startup creation, joint ventures, collaborative commercialization, open innovation models. TTOs evaluate: market readiness, regulatory barriers, competitive landscape, investment requirements, commercialization timelines.

Innovation Brokers

Innovation brokers are professionals who facilitate connections between different ecosystem actors. They help bridge the gap between scientific research, business needs, investment opportunities and public policy. Skills that are required for innovation brokers: technical understanding, business knowledge, communication skills, strategic thinking, interdisciplinary competence

Typical Commercialization Pathway

1. Research discovery

Researchers develop a potentially valuable scientific or technological innovation.

2. Invention disclosure

Researchers submit an invention disclosure to the TTO. The disclosure includes technical description, inventors, funding information, potential applications.

3. Patent assessment

TTOs evaluate novelty, inventive step, market potential, commercialization feasibility and prior art. Patent attorneys and technical experts participate in this evaluation.

4. IP protection

If commercialization potential exists, the university may file patent applications, establish confidentiality measures or develop another IP strategy.

5. Market Analysis

Commercialization teams assess customer needs, competing technologies, regulatory requirements, market size and business opportunities.

This stage often determines whether commercialization is economically viable.

6. Licensing or startup creation

Licensing may be preferable when large-scale infrastructure is required and established distribution networks already exist.

Startups may be preferable when disruptive innovation creates new markets, researchers wish to become entrepreneurs, technology requires specialized development.

7. Commercial Deployment

The technology enters the market through product launch, industrial integration, clinical implementation and software deployment. Commercial deployment often requires: regulatory approval, manufacturing capacity, scaling strategies, customer support.

Challenges facing TTOs:

- limited funding,
- long commercialization timelines,
- high technological risk,
- regulatory complexity,
- limited researcher engagement,
- balancing academic and commercial priorities.

Reflection questions:

1. Should all university research be commercialized?
2. What are the advantages of startup creation compared with licensing?
3. How can TTOs improve collaboration between academia and industry?
4. What challenges make technology transfer difficult?

7. Ethics and Compliance in Innovation

Why ethics is important?

Technology transfer and commercialization create significant social responsibilities. Scientific discoveries and emerging technologies can improve quality of life, strengthen economies, and solve global challenges. However, innovation may also generate unintended negative consequences if ethical considerations are ignored. Responsible innovation requires balancing: scientific progress, economic interests, public welfare, environmental sustainability, human rights. Organizations involved in technology transfer must therefore evaluate not only whether a technology can be commercialized, but also whether it should be commercialized and under what conditions.

Ethical challenges in technology transfer

1. Data privacy

Modern technologies increasingly rely on the collection and processing of personal data, such as AI systems, wearable medical devices, smart city infrastructure, educational platforms, biometric systems, mobile applications.

Improper handling of personal data may lead to surveillance, identity theft, unauthorized profiling, discrimination, loss of public trust.

Key ethical questions:

- Who owns collected data?
- How is consent obtained?
- Can users control or delete their data?
- Is data securely protected?
- Are users fully informed about data usage?

For example: A university spin-off develops an AI-based health monitoring application collecting sensitive medical data from patients. Ethical concerns include: informed consent, secure storage of health information, potential commercialization of personal data, cross-border data transfer.

Good practices include:

- compliance with GDPR and privacy regulations,

- anonymization and encryption,
- transparency in data processing,
- minimal data collection,
- cybersecurity protection.

2. AI bias and algorithmic discrimination

Artificial intelligence systems learn from data. If training data contain social biases, AI systems may reproduce or amplify discrimination.

Examples: facial recognition systems performing poorly on certain ethnic groups, recruitment algorithms favouring one gender, healthcare AI producing unequal diagnostic accuracy, credit scoring systems discriminating against vulnerable populations.

Ethical questions

- Who audits AI systems?
- How transparent should algorithms be?
- Can users challenge automated decisions?
- How can fairness be measured?

Mitigation strategies

- diverse and representative datasets,
- independent auditing,
- explainable AI approaches,
- interdisciplinary oversight teams,
- continuous monitoring after deployment.

3. Misuse of biotechnology

Biotechnology offers enormous benefits in medicine, agriculture, and environmental protection. However, it may also create ethical and security concerns.

Potential risks:

- genetic manipulation without proper oversight,
- unethical human experimentation,
- creation of harmful biological agents,
- unauthorized use of genetic data,
- ecological disruption
- dual-use (some biotechnologies can be used for both beneficial and harmful purposes)

Ethical questions:

- What limits should exist in genetic engineering?
- Who regulates access to advanced biotechnology?
- How should biological risks be monitored?
- How can public safety be protected?

Example: A university research group develops advanced gene-editing technology. Commercialization opportunities may exist in personalized medicine, agriculture or pharmaceutical development. However, the technology could also potentially be misused for unethical genetic modification. Responsible biotechnology commercialization requires: ethics committee oversight, biosafety procedures, regulatory compliance and transparent research protocols.

4. Unequal access to technology

Technological innovation may increase inequality when access is limited to wealthy individuals, regions, or countries. Examples: expensive life-saving medicines, limited internet access, unequal access to AI technologies, educational technology gaps, lack of access to renewable energy infrastructure.

Ethical concerns: social exclusion, digital divide, unequal healthcare outcomes, concentration of technological power.

Ethical questions:

- Should essential technologies be universally accessible?
- How can innovation remain profitable while supporting social inclusion?
- What responsibilities do universities have toward society?

Possible solutions:

- open innovation models,
- tiered pricing systems,
- humanitarian licensing,
- public-private partnerships,
- technology access programs.

5. Environmental impact

Technology commercialization may create environmental benefits or environmental harm.

Potential environmental risks are: electronic waste, pollution, excessive energy consumption, resource depletion, greenhouse gas emissions.

Example: Large-scale AI systems and data centres require significant electricity consumption and cooling infrastructure. Similarly, rapid production of electronic devices may contribute to rare-earth mineral extraction, toxic waste, unsustainable manufacturing.

Responsible innovation increasingly incorporates:

- circular economy principles,
- renewable energy use,
- eco-design,
- life-cycle assessment,
- carbon footprint analysis.

Ethical questions:

- Does commercialization prioritize short-term profit over sustainability?
- How should environmental costs be measured?

- Who is responsible for long-term ecological consequences?

6. Conflicts of interest

Conflicts of interest occur when personal, financial, or professional interests interfere with objective decision-making.

Examples:

- a researcher evaluating their own startup,
- university staff receiving personal financial benefits from licensing decisions,
- biased research sponsored by industry partners,
- pressure to commercialize incomplete or unsafe technologies.

Ethical questions:

- Should researchers hold equity in spin-off companies?
- How transparent should financial relationships be?
- Who should supervise commercialization decisions?

Conflict management mechanisms:

- disclosure requirements,
- ethics committees,
- independent review panels,
- transparency procedures,
- institutional compliance offices.

Building ethical innovation ecosystems:

Ethical technology transfer requires a culture of responsibility. Organizations should integrate ethics into innovation strategy, provide ethics training, encourage transparency, engage stakeholders and establish accountability mechanisms.

Ethics committees:

Universities often establish ethics committees to evaluate research involving humans, biological materials, sensitive data, high-risk technologies.

Reflection exercise:

Can a technology be legally compliant but ethically problematic? Give an example.

8. Advanced Perspectives on Intellectual Property and Innovation

Open innovation and collaborative research

Traditional innovation models assumed that organizations developed technologies internally and protected them from external access. Today, this approach is increasingly replaced by collaborative innovation ecosystems involving universities, companies, governments, startups,

non-governmental organizations, and international research networks. This model is commonly known as open innovation.

The concept of open innovation was popularized by Henry Chesbrough, who argued that organizations should use both internal and external ideas, technologies, and commercialization pathways. In practice, this means that organizations increasingly:

- co-develop technologies,
- share research infrastructure,
- participate in international research consortia,
- collaborate through innovation hubs and accelerators,
- exchange knowledge through licensing and partnerships.

Examples of open innovation:

- pharmaceutical companies collaborating with universities on vaccine development,
- automotive manufacturers partnering with AI startups,
- public-private partnerships in renewable energy,
- open-source software ecosystems,
- European research consortia funded under Horizon Europe.

Benefits of open innovation:

- faster technology development - collaboration allows organizations to combine expertise, data, and infrastructure, significantly reducing research and development time;
- lower research costs - research infrastructure and development expenses can be shared among partners.

Open science vs commercialization

Universities are expected to generate scientific knowledge, educate society, publish research openly, contribute to economic development. However, commercialization frequently requires temporary confidentiality. Public disclosure before patent filing may destroy patentability. As a result, universities must balance: scientific openness, commercial protection, public interest and economic sustainability.

Artificial intelligence and intellectual property

Artificial intelligence is reshaping innovation, research, and intellectual property management.

Emerging legal issues in AI and IP:

- Can AI-generated Inventions be patented?

Traditional patent law assumes that inventors are human beings. However, advanced AI systems may independently generate engineering solutions, chemical structures or optimization strategies. Several countries have already faced legal disputes concerning AI-generated inventions. Most legal systems currently reject AI systems as inventors, but debate continues.

- Who is the owner of AI-generated content?

Questions arise regarding ownership of AI-generated images, software code, music, research outputs, educational materials.

Possible ownership candidates include: AI developers, users of AI systems, organizations deploying the AI, no one (public domain).

AI systems are trained on enormous datasets that may contain: copyrighted material, personal data, confidential information, biased or harmful content.

Key concerns include: copyright infringement, unauthorized data scraping, privacy violations, ethical use of datasets.

AI in patent analysis

AI tools increasingly support intellectual property management. AI can analyse millions of patent documents significantly faster than humans. Machine learning systems can identify technological similarities and hidden relationships between inventions.

AI in technology forecasting

AI helps organizations identify emerging research trends, technological gaps, future market opportunities.

Infringement detection

AI systems can monitor products and technologies to identify potential patent infringement.

Sustainability in technology commercialization

Modern innovation policy increasingly prioritizes sustainable development. Commercialization strategies are now expected to consider environmental impact, resource efficiency, social responsibility, long-term sustainability. Governments, investors, and international organizations increasingly support technologies aligned with sustainability goals. ESG (environmental, social, governance) criteria are increasingly used by investors when evaluating startups and companies. Environmental factors: carbon emissions, energy efficiency, waste management, climate impact. Social factors: labour practices, diversity and inclusion, community impact, data ethics.

Governance factors: transparency, anti-corruption policies, accountability, ethical leadership.

Strong ESG performance may improve investor confidence, reduce regulatory risk, strengthen reputation, support long-term sustainability. On the other hand, poor ESG performance may lead to financial losses, reputational crises and legal consequences.

Reflection questions

1. Can open innovation increase both collaboration and IP conflicts?
2. Should AI systems be recognized as inventors?
3. How can commercialization support sustainability goals?
4. Is commercialization always necessary for knowledge valorization?

Lesson 1 Summary

In this lesson, learners explored:

- the foundations of intellectual property,
- different forms of IP protection,
- innovation ecosystems,
- patentability and prior art,
- university technology transfer,
- ethical and legal considerations.

Lesson 2: Legal Frameworks and Contractual Instruments in Technology Transfer

Lesson overview. The lesson examines contractual instruments and legal risk management in technology transfer. It covers IP ownership models, NDAs, MTAs, JDAs, conflict of interest, compliance and international and regional legal frameworks.

Learning outcomes

- Explain IP ownership models and common contractual provisions.
- Identify the purposes of NDAs, MTAs and JDAs.
- Recognize legal risks such as infringement, privacy violations and regulatory non-compliance.
- Explain compliance and risk-mitigation measures.
- Describe key international frameworks relevant to technology transfer.

Core topics

- IP ownership in university–industry collaboration
- IP clauses and publication rights
- Non-Disclosure Agreements (NDAs)
- Material Transfer Agreements (MTAs)
- Joint Development Agreements (JDAs)
- Conflict-of-interest management
- Legal risk management and compliance
- International and regional frameworks: WIPO, PCT, EPO, Horizon Europe and TRIPS
- GDPR, export controls, standards and certification

Learning activity / reflection

Choose one contractual instrument and create a checklist of provisions that should be reviewed before signature. Explain what risk each provision addresses.

Lesson summary

Legal governance should be integrated into commercialization planning rather than treated as a final administrative step.

1. IP Ownership in University–Industry Collaboration

Ownership may depend on the relative contribution of each organization. Contributions may include: scientific expertise, laboratory infrastructure, funding, data, software, technical know-how, commercialization support. Determining contribution levels may become difficult in interdisciplinary collaborations.

University ownership

The university owns inventions created by employees within the scope of their employment duties. This is one of the most common models in academic research. University ownership often applies when:

- university laboratories are used,
- research is publicly funded,
- inventions arise from official research projects,
- researchers are university employees.

Advantages: University ownership may centralize IP management, simplify commercialization, support long-term institutional strategy, strengthen Technology Transfer Offices.

Challenges: Researchers may sometimes feel insufficiently rewarded, limited in entrepreneurial freedom, constrained by administrative procedures.

Joint ownership

Joint ownership means that two or more organizations share ownership of intellectual property.

This commonly occurs when:

- multiple parties contribute to invention development,
- collaborative funding is used,
- interdisciplinary partnerships are established.

Typical examples are: university–industry research projects, international research consortia, public-private partnerships, collaborative laboratories.

Advantages: Joint ownership may encourage collaboration, distribute costs and risks, combine complementary expertise, strengthen commercialization capacity.

Challenges: disagreement regarding licensing strategy, conflicts over patent costs, territorial commercialization disputes, differing business objectives, unequal contribution perceptions, restrictions on sublicensing.

Industry ownership

The industry partner owns the intellectual property. This model often applies when:

- the company fully funds the research,
- research is highly application-oriented,
- contract research agreements exist.

Advantages for industry: accelerate commercialization, simplify decision-making, strengthen competitive advantage, reduce negotiation complexity.

Concerns for universities: limited publication rights, restricted academic freedom, reduced long-term societal access, limited financial return. Universities therefore often negotiate publication rights, access for future research, revenue-sharing mechanisms.

Intellectual property clauses in collaboration agreements

University–industry agreements may include detailed IP clauses. Common contractual provisions:

- ownership definitions,
- patent filing responsibilities,
- licensing rights,
- publication procedures,
- confidentiality obligations,
- dispute resolution mechanisms,
- commercialization responsibilities.

Publication rights and academic freedom

One of the most sensitive issues in university–industry collaboration concerns publication. Researchers usually prioritize scientific publication, academic recognition, open knowledge exchange. From industry perspective most important is confidentiality, patent protection and competitive advantage. The contract should balance those interests, for instance by allowing temporary publication delays, patent filing before publication, review periods for confidential information.

Best Practices in university–industry collaboration

Successful collaborations typically involve:

- clear contractual agreements,
- early IP discussions,
- transparent communication,

- conflict-management mechanisms,
- clearly defined commercialization strategies.
- shared goals
- mutual respect and trust

Discussion question:

What challenges might arise when two organizations jointly own a patent? Consider: commercialization rights, licensing authority, revenue distribution, publication rights, international legal differences, strategic conflicts.

Reflection questions:

1. Should universities always retain ownership of publicly funded research?
2. What are the advantages and disadvantages of joint ownership?
3. How can publication freedom be balanced with commercialization?
4. What factors are most important in negotiating collaboration agreements?

2. Employment Contracts and Research Ownership

Employment-based inventions

An employment-based invention is usually defined as an invention developed:

- within the scope of employment duties,
- using employer resources,
- during funded research activities,
- through projects assigned by the employer.

In many jurisdictions, employers automatically receive rights to inventions created by employees during employment.

However, rules differ depending on:

- national law,
- institutional policy,
- employment contracts,
- funding agreements.

Typical clauses in research employment contracts

1. Invention disclosure obligations

Researchers are often required to report inventions to the employer before: publication, conference presentations, public disclosure, commercialization discussions. This helps institutions evaluate patentability, commercialization potential and legal protection strategies. Researchers may need to provide technical descriptions, inventor names, funding information, possible applications, dates of invention. It is important because premature public disclosure may destroy patent novelty, weaken commercialization opportunities and reduce investor interest.

2. Confidentiality Requirements

Research contracts commonly require employees to protect confidential information. Confidential information may include unpublished research, algorithms, prototypes, experimental data, industrial know-how, commercialization strategies. Employees may be prohibited from sharing information externally, using confidential data for personal gain, disclosing trade secrets after employment ends.

3. Assignment of IP rights

Employment agreements frequently require researchers to assign intellectual property rights to the institution. Assignment clauses may specify which inventions are covered, when rights transfer occurs, employee obligations during patent filing.

4. Publication procedures

Publication is central to academic careers, scientific reputation and research evaluation. On the other hand, commercialization may require delayed publication, confidentiality periods and patent filing before disclosure.

Many institutions use procedures such as temporary publication embargoes, coordinated patent filing, pre-publication review. These mechanisms attempt to balance scientific openness and commercialization objectives.

5. Revenue-sharing rules

Revenue-sharing clauses define how commercialization income is distributed. Revenues are often shared among inventors, departments and TTO's.

Financial incentives may encourage invention disclosure, strengthen entrepreneurial culture, motivate researchers to participate in commercialization.

Employee vs student ownership

Student inventions generally belongs to students. However, the contracts between university and students may specify otherwise.

Industry-sponsored research

Industry-funded projects often include additional contractual provisions. Companies may negotiate ownership rights, exclusive licensing, confidentiality, publication restrictions.

Best practices in research contracts

- clear ownership definitions,
- transparent disclosure procedures,
- balanced publication rules,
- fair revenue-sharing systems,
- conflict-resolution mechanisms.

Reflection questions

1. Should researchers automatically own inventions they create?
2. How can universities balance commercialization and academic freedom?
3. What risks arise when ownership is unclear?

4. Non-Disclosure Agreements (NDAs)

A Non-Disclosure Agreement (NDA), also known as a confidentiality agreement, is a legal contract used to protect confidential information shared between parties. The primary purpose of an NDA is to establish legal obligations preventing unauthorized disclosure or misuse of confidential information.

NDA may be:

- unilateral – only one party disclose information to the other one;
- mutual - both parties exchanging confidential information;
- multilateral - involves multiple organizations

Universities often use NDAs when:

- discussing unpublished research with companies,
- sharing prototypes with industry partners,
- evaluating commercialization opportunities,
- collaborating on funded research projects.

Startups frequently use NDAs when:

- presenting technologies to investors,
- discussing partnerships,
- sharing business plans,
- outsourcing software development.

3. Typical NDA provisions

1. Definition of confidential information

The agreement specifies what information is considered confidential. Confidential information may include inventions, prototypes, software, algorithms, business plans, datasets, research results, technical documentation, customer information, commercialization strategies. Overly broad definitions may become difficult to enforce. Definitions that are too narrow may fail to provide adequate protection.

2. Obligations of the receiving party

The receiving party is usually required to protect confidential information, limit internal access, avoid unauthorized disclosure, use information only for agreed purposes. The agreement may also require cybersecurity protections, secure data storage, restricted document sharing.

3. Permitted disclosures

NDAs often specify exceptions where disclosure is allowed. Examples include disclosure required by law, disclosure to authorized employees or advisors, disclosure with written consent. The receiving party may still be required to minimize exposure.

4. Duration of confidentiality

The NDA defines how long confidentiality obligations remain in effect. Confidentiality periods may range from several years to indefinite protection for trade secrets. Trade secrets may require protection as long as the information remains commercially valuable and confidential.

5. Return or destruction of information

Many NDAs require the receiving party to return documents, destroy copies or delete digital files after discussions or collaboration end.

6. Remedies for breach

NDAs may specify legal remedies if confidentiality is violated. Possible remedies include: financial damages, injunctions, termination of collaboration, legal liability.

NDAs and digital technologies

Digital transformation creates new confidentiality challenges: cyberattacks, cloud-data breaches, remote collaboration, unauthorized AI training, data scraping. Organizations increasingly combine NDAs with:

- encryption,
- access controls,
- cybersecurity audits,
- secure cloud systems.

International challenges in NDAs

International collaboration introduces additional legal complexity: jurisdiction, enforceability, cross-border data transfer, different confidentiality laws, international dispute resolution. NDAs often specify governing law, jurisdiction, arbitration mechanisms.

Limitations of NDAs

Although NDAs are important, they are not perfect protection mechanisms. Practical limitations include: enforcement may be expensive, proving disclosure can be difficult, information may leak unintentionally,

Reflection questions:

1. Why are NDAs important before patent filing?
2. What risks arise when confidential information is shared without protection?
3. Should universities prioritize openness or confidentiality?
4. Can excessive confidentiality slow scientific innovation?

4. Material Transfer Agreements (MTAs)

Purpose of Material Transfer Agreements

Material Transfer Agreements (MTAs) are legal contracts regulating the transfer, sharing, and use of research materials between organizations. Researchers frequently exchange: biological materials, chemical compounds, software tools, datasets, prototypes or laboratory resources.

Without clear legal agreements, such transfers may create uncertainty regarding: ownership, permitted use, publication rights, commercialization opportunities, liability for misuse.

MTAs therefore reduce legal and operational risks while supporting collaborative research.

MTAs may apply to a wide range of tangible and intangible research materials.

Biological samples

Biological materials such as cell lines, tissue samples, blood samples, microorganisms, DNA or RNA materials, GMOs, are among the most common resources regulated through MTAs. Biological materials may involve biosafety risks, ethical concerns, patient privacy, regulatory restrictions, commercial potential. Strict legal and ethical oversight is therefore necessary.

Chemical compounds

Chemical substances such as drug candidates, catalysts, nanomaterials, laboratory reagents are frequently exchanged during pharmaceutical research materials science, biotechnology

collaboration. Improper use may create safety hazards, environmental risks or intellectual property disputes.

Software prototypes

Research collaborations increasingly involve software-based innovation such as AI algorithms, machine-learning models, simulation software, cybersecurity tools, research platforms. MTAs for software may address source-code access, modification rights, reverse engineering, cybersecurity obligations or licensing restrictions.

Datasets

Data sharing (for example: medical, genomic, environmental monitoring, industrial) has become central to modern research. Data transfer may involve privacy regulations, GDPR compliance, confidentiality, cybersecurity, ethical governance.

Laboratory tools and research equipment

Research collaborations may involve transfer of specialized instruments, prototypes, laboratory kits, experimental devices, testing equipment. MTAs help define usage rights, maintenance responsibilities, liability for damage.

Key elements of MTAs

1. Ownership of Materials

The agreement specifies who owns the original material, whether derivatives may be created, who owns modifications or improvements.

2. Permitted use

The agreement defines how transferred materials may be used. Materials may be restricted to: non-commercial research, internal laboratory use, specific research projects, educational purposes. Some MTAs prohibit commercial use, sublicensing, third-party transfer, industrial application without additional agreements.

3. Restrictions and prohibited activities

MTAs commonly prohibit unauthorized sharing, reverse engineering, replication, commercial exploitation, use outside agreed projects. Restrictions help protect: intellectual property, biosafety, competitive advantage.

4. Publication rights

Researchers often wish to publish research findings. Organizations providing materials may seek confidentiality, pre-publication review, protection of trade secrets, patent filing before publication. MTAs frequently establish publication review periods, confidentiality limitations, acknowledgment requirements.

5. Liability and risk allocation

MTAs define responsibility for misuse of materials, laboratory accidents, contamination, injuries, regulatory violations. Providers often transfer materials “as is” without guarantees regarding safety,

effectiveness, fitness for purpose. Recipients may assume responsibility for safe handling, regulatory compliance, biosafety procedures.

6. Confidentiality

MTAs frequently include confidentiality obligations.

Frequent challenges:

- ownership disputes,
- publication conflicts,
- liability concerns,
- excessive restrictions,
- conflicting institutional policies.

Best Practices for MTAs:

Effective MTAs typically:

- clearly define ownership,
- establish realistic usage rights,
- balance research openness and protection,
- address commercialization early,
- include dispute-resolution mechanisms.

Reflection questions:

1. Why are MTAs especially important in biotechnology research?
2. What risks arise if ownership of derivatives is unclear?
3. How can MTAs balance openness and commercialization?

5. Joint Development Agreements (JDAs)

Collaborative development

Joint Development Agreements (JDAs) are legal contracts governing collaborative research, innovation, and technology-development projects between two or more organizations. JDAs establish the legal, financial, operational, and intellectual-property framework for cooperation during the development of new technologies, products, or services. They are widely used in university–industry collaboration. JDAs are especially important when multiple parties contribute expertise, funding, infrastructure, data, intellectual property or personnel.

Why JDAs are important

Collaborative innovation creates significant opportunities but also introduces legal and organizational complexity. Without a clear agreement, disputes may arise regarding: ownership of inventions, publication rights, commercialization authority, licensing revenues, project responsibilities, confidentiality obligations.

Typical areas covered by JDAs

Joint Development Agreements usually include detailed provisions regulating the entire collaboration process.

1. Project responsibilities

JDAs specify what each party is expected to contribute. Responsibilities may include scientific research, software development, laboratory testing, regulatory compliance, prototype manufacturing, commercialization planning. Clearly defined responsibilities: improve project coordination, reduce duplication, prevent misunderstandings and support accountability.

Example: A university may provide scientific expertise, laboratory infrastructure, researchers. An industrial partner may provide funding, engineering support, manufacturing capabilities, market access.

2. Milestones

Milestones help structure project progress and performance evaluation. They may define: technical targets, prototype completion, regulatory approvals, clinical validation, or commercialization readiness. Milestones improve project management, support investor confidence, enable funding-stage evaluation, reduce development risk. Some JDAs connect: funding release, licensing rights or commercialization decisions to milestone achievement.

3. Cost-sharing

Collaborative projects often involve significant development costs. JDAs define who funds specific activities, introduce cost-allocation mechanisms, reimbursement rules and budget responsibilities. Examples of shared costs: laboratory expenses, patent filing, regulatory testing, software infrastructure, clinical trials, manufacturing prototypes. Transparent financial structures reduce disputes, support long-term collaboration and improve financial planning.

4. Intellectual property ownership

IP ownership is often the most sensitive aspect of collaborative innovation. JDAs define: ownership of new inventions, ownership of improvements, rights to derivative technologies, patent-filing authority.

Background IP vs Foreground IP

Background IP refers to intellectual property existing before collaboration begins. Usually background IP should belong to the party that generates it. The other party may have the right to

use it for the project realisation reasons. Examples: existing patents, software, datasets, algorithms, know-how.

Foreground IP refers to intellectual property created during the collaboration. JDAs must define who owns foreground IP, whether ownership is shared, how commercialization rights are allocated.

5. Licensing rights

JDAs frequently define how technologies may be licensed. The agreement may specify: exclusive licensing, non-exclusive licensing, territorial rights, sublicensing permissions or field-of-use limitations.

6. Commercial implementation

The agreement may determine which party leads commercial implementation of the project results, who manages manufacturing, who handles marketing, who negotiates customers, who receives commercialization revenues.

Some JDAs allow creation of joint ventures, startup formation, spin-off commercialization.

7. Dispute Resolution

Collaborative innovation projects are complex and may last many years. Potential conflicts include ownership disputes, milestone disagreements, confidentiality breaches, publication conflicts and commercialization delays. JDAs may include mediation, arbitration, court jurisdiction, escalation procedures. Alternative dispute resolution mechanisms are often preferred because they are faster, less expensive, more confidential.

8. Publication rights

JDAs often establish publication-review periods, temporary embargoes, confidential-information screening, coordinated patent filing procedures.

Reflection question:

Why is it important to define publication rights in collaborative research? Consider patentability, academic freedom, confidentiality, commercialization timing, open science, competitive advantage.

6. Conflict of Interest and Institutional Policies

A conflict of interest (COI) occurs when personal, financial, professional, or organizational interests interfere or appear to interfere with objective professional responsibilities. A conflict does not necessarily mean misconduct has occurred. However, unmanaged conflicts may influence decision-making, research integrity, objectivity and public trust. For this reason, universities and research institutions establish formal policies to identify, disclose, and manage conflicts of interest.

Different roles of researches

Researchers may simultaneously act as scientists, inventors, startup founders, consultants, shareholders or industry advisors. While these roles can stimulate innovation, they may also create situations where private interests influence professional judgment.

Types of conflicts of interest

- financial conflicts of interest - occur when individuals may personally benefit financially from research or commercialization outcomes

Examples: owning shares in a startup, receiving consulting fees, obtaining royalties, holding stock options, receiving industry funding.

- professional conflicts of interest - occur when career advancement or institutional interests influence professional judgment.

Examples: promoting a collaborator's technology, favoring certain companies, influencing hiring or funding decisions, reviewing competitors' proposals.

- academic conflicts of interest – occur when publication decisions, student supervision, peer review, research evaluation are influenced by personal interests.

Example: a researcher evaluates grant proposals submitted by close collaborators or competitors.

- personal conflicts of interest

Personal relationships may also create conflicts.

Examples: supervising family members, collaborating with close friends, participating in hiring decisions involving relatives.

Common conflict-of-interest universities:

Example 1: Startup Ownership - A professor owns shares in a startup commercializing university research.

Potential concerns: biased research results, preferential treatment, misuse of university resources, conflicts in licensing negotiations.

Example 2: Evaluating a Commercial Partner - A researcher evaluates technology developed by a company that financially supports their laboratory.

Potential concerns: lack of objectivity, biased scientific conclusions, compromised peer review.

Example 3: Student Supervision - A scientist supervises students who also work for the scientist's private company.

Potential risks: exploitation of students, pressure to prioritize commercial work, unclear ownership of research results.

Example 4: Industry-funded research - A pharmaceutical company funds university research evaluating its own products.

Potential concerns: selective publication, data manipulation, pressure on researchers, publication restrictions.

Institutional responses to conflict of interest

Universities and research institutions establish governance systems to manage conflicts responsibly.

1. Disclosure obligations - transparency as a core principle

Researchers are often required to disclose financial interests, consulting activities, startup ownership, board memberships, industry funding, family relationships relevant to research.

Disclosure does not automatically prohibit activities. Instead, it enables institutions to assess and manage risks.

Many universities require annual disclosures, project-specific disclosures, disclosure updates after major changes. Transparency reduces hidden conflicts and improves accountability.

2. Ethics committees - oversight structures

These bodies evaluate potential conflicts, ethical risks, management strategies. Committees may review disclosures, recommend safeguards, impose restrictions, monitor compliance, investigate misconduct.

3. Transparency requirements - public and institutional

Transparency mechanisms may include public disclosure of industry funding, publication of conflict statements, open reporting procedures. Public trust in science depends heavily on transparency. Failure to disclose conflicts may damage credibility, reduce confidence in research, create reputational crises.

Practical example

A university professor develops an AI-based healthcare platform and co-founds a startup commercializing the technology.

Potential conflicts include: evaluating the technology in university studies, supervising students contributing to the startup, influencing licensing negotiations.

The university may require disclosure of financial interests, independent oversight, separation of supervisory roles, ethics committee review.

These measures help to protect: scientific integrity, students, institutional credibility.

Reflection questions

1. Can researchers remain objective when they financially benefit from commercialization?
2. Should universities limit startup involvement by professors?
3. How can institutions balance entrepreneurship and scientific integrity?
4. Why is transparency essential in innovation ecosystems?

7. Legal Risk Management and Compliance

Technology transfer and commercialization involve significant legal, regulatory, and ethical complexity. Universities, startups, research institutes, and companies operate within environments shaped by intellectual property law, data-protection regulations, export-control systems, research-governance rules or international compliance frameworks.

Failure to manage legal risks effectively may result in financial losses, litigation, regulatory penalties, reputational damage and commercialization failure.

Legal risk management therefore plays a critical role in responsible innovation and technology commercialization.

Technology commercialization often involves multiple organizations, international collaboration, sensitive data, intellectual property, regulated technologies, complex contractual relationships.

Effective legal risk management helps organizations to reduce uncertainty, protect innovation, maintain compliance, attract investors, support sustainable commercialization.

Common legal risks in technology transfer:

1. Patent infringement

Patent infringement occurs when a technology uses patented inventions without authorization.

This may involve manufacturing, selling, importing, using or distributing a protected invention.

2. Data privacy violations

Improper handling of data may violate privacy regulations. The common risks are: unauthorized data access, improper data sharing, insecure storage, excessive data collection, lack of informed consent. In Europe, the General Data Protection Regulation (GDPR) establishes strict requirements regarding data collection, consent, processing, international transfer, and cybersecurity.

3. Export control breaches

Export-control regulations restrict transfer of certain technologies, software, materials and research data across borders. They relate to military and dual use technologies and are meant to protect national security. Dual-use technologies are those technologies that may have both civilian and military applications. For example: advanced AI systems, biotechnology, aerospace technologies.

International research projects may unintentionally violate export-control regulations through data sharing, cloud access, software transfer or remote collaboration. Universities increasingly require export-control compliance programs.

4. Confidential information leaks

Unauthorized disclosure of information may lead to detrimental effects on patentability, competitive advantage and partnership agreements. The most common sources on such breaches are cyberattacks, employee misconduct or poor document management.

Trade secrets lose protection once confidentiality is lost. That is why the NDAs, cybersecurity, access controls and compliance training are essential.

5. Regulatory non-compliance

Many technologies require compliance with:

- healthcare regulations (clinical trials, ethical approval, regulatory certification)
- environmental standards (sustainability assessments, environmental permits, waste-management)
- cybersecurity requirements
- clinical-testing rules,
- AI governance frameworks (transparency requirements, bias monitoring, accountability obligations)

Regulatory violations may lead to fines, commercialization delays, product recalls or market-access restrictions.

Risk mitigation strategies

1. Legal audits

Legal audits systematically evaluate contracts, IP ownership, compliance procedures and regulatory obligations. It may help to identify weaknesses, reduce liability and improve governance.

2. Compliance training

Compliance systems are effective only when employees understand legal responsibilities. Training programs may address IP protection, confidentiality, data privacy, export control, ethical research conduct. Researchers may unintentionally create legal risks through premature publication, improper data handling or unauthorized software use. Training improves awareness and prevention.

3. IP portfolio management

IP portfolio management involves patent monitoring, renewal decisions, infringement analysis, licensing strategy, competitive intelligence.

4. Proper documentation

Good documentation supports patent filing, strengthens legal evidence, improves compliance, reduces disputes.

5. Freedom-to-operate (FTO) analysis

Freedom-to-operate analysis evaluates whether commercialization may infringe existing intellectual property rights. FTO studies examine patents, patent applications and licensing barriers. A university may own patents but still infringe others' rights (for instance someone's exclusive licencing rights).

Beyond Formal Rules

Effective compliance requires more than legal procedures. Successful institutions build organizational cultures encouraging:

- integrity

Conducting research and commercialization honestly and ethically by accurate reporting, ethical decision-making, respect for regulations and responsible authorship

- transparency

It improves public trust, investor confidence and collaboration possibilities by conflict-of-interest disclosure, publication of funding sources, open governance structures

- accountability

It ensures that responsibilities are clear, decisions are documented, misconduct is addressed.

- responsible innovation.

It integrates ethics, sustainability, legal compliance and societal impact into technology development. It concerns environmental impact, social consequences, AI ethics, inclusiveness, and long-term sustainability. It is becoming a strategic requirement for investors, regulators, governments and international funding agencies.

Risk management in Universities

Universities face unique challenges because they combine:

- academic openness,
- entrepreneurship,
- public funding,
- international collaboration.

Reflection questions:

1. Why is legal compliance essential in technology commercialization?
2. How can poor compliance damage public trust?
3. Should universities prioritize commercialization speed or regulatory caution?

8. International and Regional Legal Frameworks

Global technology transfer environment

Modern innovation and technology commercialization increasingly operate across national borders. Scientific research, startup ecosystems, venture capital, and industrial collaboration are now deeply international.

Technologies developed in one country may be patented internationally, manufactured in another region, commercialized globally, regulated under multiple legal systems.

As a result, technology transfer requires understanding not only national law but also international and regional legal frameworks.

Innovation ecosystems depend heavily on international collaboration, global research networks, multinational commercialization and cross-border investment.

Without harmonized legal frameworks, international innovation would become significantly more difficult.

International frameworks help standardize legal procedures, reduce uncertainty, improve cooperation and facilitate technology commercialization.

Challenges of cross-border technology transfer

1. Different patent systems

Patent protection is territorial. A patent granted in one country does not automatically apply internationally. Organizations must therefore manage multiple filing systems, regional regulations and international patent strategies.

2. Different data-protection rules

Countries apply different rules regarding privacy, cybersecurity, AI governance and cloud-data transfer. International projects involving personal data may face complex compliance requirements.

3. Export-control regulations

Some technologies cannot be freely transferred internationally. Restrictions may apply to dual-use technologies, encryption systems, biotechnology, AI applications, aerospace technologies.

4. Regulatory differences

Medical devices, pharmaceuticals, and AI systems may require different certifications, separate approval procedures, region-specific compliance documentation. This increases commercialization complexity.

Important international frameworks

1. World Intellectual Property Organization (WIPO)

The World Intellectual Property Organization is a specialized agency of the United Nations responsible for promoting international intellectual-property cooperation.

WIPO plays a central role in:

- patent cooperation,
- copyright governance,
- trademark systems,
- international IP harmonization.

Main functions of WIPO:

- development of international IP standards,
- dispute-resolution systems,
- patent-information databases,
- technology-transfer initiatives,
- innovation policy development.

Patent Cooperation Treaty

One of WIPO's most important systems is the Patent Cooperation Treaty (PCT). The PCT simplifies international patent filing by allowing applicants to submit one international application, in one language, through one procedure. This helps innovators seek protection in multiple countries simultaneously.

Advantages: reduced administrative burden, delayed national filing costs, international prior-art search, improved commercialization planning.

2. European Patent System

The European Patent Office manages the European patent system. The EPO enables inventors to seek patent protection across multiple European countries through a centralized procedure.

Advantages:

- simplified filing - applicants may submit one European patent application evaluated through one examination process;
- strong regional integration - the European system supports regional innovation, international commercialization, cross-border investment;
- patent information access - the EPO provides extensive patent databases such as Espacenet or CPC classification systems;
- unitary patent system - Europe is increasingly implementing a unitary patent framework. This system aims to reduce patent costs, simplify enforcement and strengthen European innovation competitiveness.

3. Horizon Europe regulations

Horizon Europe is the European Union's flagship research and innovation funding program.

It supports scientific excellence, industrial innovation, sustainability, digital transformation, and technology commercialization.

Horizon Europe strongly emphasizes exploitation of research results, knowledge valorization, commercialization, startup creation and international collaboration.

Projects funded under Horizon Europe often require exploitation plans, dissemination strategies and IP management procedures.

International research consortia funded by Horizon Europe typically establish ownership rules, access rights, publication procedures and commercialization obligations. These agreements help coordinate multinational innovation projects.

Horizon Europe promotes open science, open-access publication, and responsible research. However, commercialization may still require temporary confidentiality and strategic patent filing.

4. WTO TRIPS Agreement

The World Trade Organization Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) establishes minimum international standards for intellectual-property protection. TRIPS is one of the most influential international IP agreements.

TRIPS aims to harmonize IP standards, reduce international trade barriers, strengthen global IP protection and support international commerce.

TRIPS regulates patents, copyright, trademarks, industrial designs, trade secrets and enforcement mechanisms. TRIPS significantly influences pharmaceutical innovation, software protection, international licensing and cross-border commercialization.

Criticism of TRIPS

Critics argue that strict IP protection may increase medicine costs, limit access to technologies, and disadvantage developing countries. This debate became especially visible during: HIV/AIDS treatment access debates and COVID-19 vaccine discussions.

5. National intellectual property laws

Although international agreements create common standards, IP rights remain primarily governed by national law. Countries differ regarding: patentability rules, software patents, employee inventions, enforcement systems or AI regulation.

Why international frameworks matter?

International legal frameworks play a crucial role in modern innovation ecosystems. International agreements reduce fragmentation by creating standardized filing systems, common terminology and coordinated procedures. This improves efficiency for researchers, startups and multinational companies.

Global frameworks facilitate research consortia, university partnerships and multinational innovation projects. International legal systems help companies expand globally, attract international investors and manage global IP portfolios.

International organizations increasingly support knowledge sharing, sustainable development and innovation capacity building.

Key challenges:

Developing countries may face limited IP infrastructure, insufficient commercialization ecosystems or restricted access to advanced technologies.

Practical example:

A university research consortium develops a renewable-energy technology involving partners from Poland, Germany, Japan and the United States. The project must address: patent filing strategy, data-sharing compliance, export-control rules, commercialization rights and Horizon Europe obligations. International legal frameworks help coordinate intellectual property, collaboration governance and commercialization planning.

Reflection questions:

1. Why is international IP harmonization important?
2. Can strong IP protection sometimes limit access to technology?
3. How does globalization influence technology transfer?

9. Advanced Legal and Regulatory Issues

Technology transfer in a complex regulatory environment

Modern technology transfer operates within increasingly complex legal and regulatory environments. Commercialization activities frequently involve intellectual property, personal data, international collaboration, cybersecurity, healthcare regulation, export controls, environmental standards.

As technologies become more advanced and globally connected, organizations must manage not only innovation itself but also extensive compliance obligations.

Failure to address legal and regulatory requirements may result in financial penalties, commercialization delays, litigation, reputational damage, restrictions on market access.

Responsible innovation therefore requires strong legal governance alongside technological development.

The growing importance of data governance

The General Data Protection Regulation (GDPR) is the European Union's comprehensive data-protection framework. GDPR applies to organizations processing personal data of individuals

located in the European Union. GDPR has become one of the world's most influential data-governance systems.

Key GDPR principles

1. Lawful processing

Organizations must process personal data only on legally valid grounds. Examples include informed consent, contractual necessity, legal obligations or legitimate interest.

2. Data minimization

Organizations should collect only the minimum amount of data necessary for a specific purpose. Excessive data collection increases privacy risks, cybersecurity exposure and compliance complexity.

3. Transparency

Individuals must understand what data is collected, why it is collected, how it is used and who receives access.

4. Purpose limitation

Personal data may only be used for clearly defined and legitimate purposes. Organizations cannot freely reuse data for unrelated activities without appropriate legal justification.

5. Data security

Organizations must implement safeguards protecting personal data against unauthorized access, cyberattacks, accidental disclosure and data loss. Security measures may include encryption, access controls, cybersecurity monitoring and secure cloud infrastructure.

Medical technologies

Healthcare innovation often involves highly sensitive data such as medical records, genetic information, biometric data, clinical research data. Medical technologies therefore require: strict consent procedures, ethical review and secure processing systems.

Export-control risks in universities

Universities increasingly participate in international collaboration involving advanced technologies. Researchers may unintentionally violate export-control laws through sharing software internationally, providing remote system access, transferring research data, collaborating with restricted entities. Universities therefore increasingly require export-control training, compliance procedures and legal review mechanisms.

Standardization and regulatory approval

Commercialization often requires compliance with technical standards, safety regulations, quality systems and certification procedures.

Standards help ensure safety, reliability, interoperability and consumer trust.

CE Marking (European Union)

CE marking demonstrates compliance with European safety and regulatory requirements.

Products requiring CE marking may include: medical devices, electronics, machinery, IoT systems.

FDA approval (United States)

Medical products in the United States may require approval from the U.S. Food and Drug Administration. FDA approval often applies to: pharmaceuticals, medical devices, diagnostic systems, digital-health technologies.

ISO quality standards

International Organization for Standardization (ISO) standards support: quality management, cybersecurity, environmental responsibility, manufacturing consistency.

Cybersecurity certifications

Digital technologies increasingly require cybersecurity compliance.

Important frameworks include: cybersecurity audits, encryption standards, penetration testing, secure software-development protocols.

International technology transfer challenges

- Differences in patent law

Countries apply different rules regarding software patents, biotechnology, employee inventions, enforcement procedures. Patent strategies must therefore be adapted internationally.

- Language barriers

International collaboration may involve legal translation challenges, communication difficulties, technical misunderstandings. Clear communication is essential for successful agreements.

- Varying enforcement systems

Some countries provide stronger IP enforcement, more efficient courts and stronger regulatory systems. Others may present enforcement uncertainty and weaker legal infrastructure.

- Taxation issues

International commercialization may involve transfer pricing, licensing taxation, cross-border revenue structures, VAT complexity. Specialized legal and financial expertise is often required.

- Political and geopolitical risks

Technology transfer increasingly intersects with geopolitical competition, trade restrictions, sanctions, national-security policy. Strategic technologies may become politically sensitive.

- Cultural factors

Business expectations vary significantly across regions. Differences may involve communication style, decision-making speed, hierarchy, contractual flexibility and relationship-building approaches. Successful international collaboration often requires cultural sensitivity, local legal expertise, flexible negotiation strategies and trust-building mechanisms.

Soft skills are often as important as legal expertise.

Responsible Research and Innovation (RRI)

Responsible Research and Innovation (RRI) promotes alignment between scientific progress and societal values. RRI encourages innovation that is ethical, sustainable, inclusive, and socially responsible.

Core principles of RRI are:

- Public engagement

Citizens and stakeholders should participate in discussions regarding emerging technologies, ethical risks and societal impact.

- Sustainability

Innovation should support environmental responsibility, long-term societal benefit and sustainable development goals.

- Gender equality

RRI promotes diversity, equal participation and inclusive research environments.

- Ethical governance

Research and commercialization should consider human rights, fairness, transparency, accountability.

- Open access

RRI supports knowledge sharing, open science and broader societal access to research results.

Reflection questions:

1. Why is GDPR important for commercialization?
2. Should universities restrict research involving dual-use technologies?
3. How do international legal differences affect commercialization strategy?
4. Can responsible innovation improve commercial success?

Lesson 2 Summary

In this lesson, learners explored:

- IP ownership models,
- employment-based inventions,
- NDAs, MTAs, and JDAs,

- conflicts of interest,
- compliance and legal risk management,
- international legal frameworks.

Lesson 3: Licensing, Commercialization and Startup Development

Lesson overview. This lesson brings legal and commercial considerations together. It covers licensing models, royalties and equity, negotiation, Freedom-to-Operate, the research-to-market pathway, TRLs, startup/spin-off creation and innovation-hub support.

Learning outcomes

- Distinguish exclusive, non-exclusive, field-limited, territorial and time-limited licensing.
- Explain upfront payments, milestones, royalties, sublicensing and equity.
- Apply negotiation principles to university–industry transactions.
- Explain Freedom-to-Operate and its role in commercialization.
- Evaluate licensing, partnership and startup pathways.
- Explain the role of innovation hubs, incubators and accelerators.

Core topics

- Technology licensing models
- Exclusive versus non-exclusive licensing
- Royalties, milestones, sublicensing and equity
- Negotiation strategy and stakeholder interests
- Performance milestones and improvement ownership
- Freedom-to-Operate analysis
- Research-to-market pathway
- Technology Readiness Levels (TRLs)
- Startup and spin-off creation
- Innovation hubs and accelerators
- Commercialization case studies

Learning activity / reflection

Compare an exclusive and a non-exclusive licensing proposal for the same technology. Consider investment incentives, market access, revenue, risk, flexibility and societal impact.

Lesson summary

Commercialization is a strategic choice. Licensing terms, FTO, financing, market readiness and stakeholder interests must be considered together rather than separately.

1. Technology Licensing Models

Licensing is a legal mechanism that allows one party (the licensor) to grant another party (the licensee) the right to use intellectual property under agreed conditions. The intellectual-property owner retains ownership while granting specific rights related to use, production, commercialization, distribution, modification or market access.

Licensing allows technology owners to commercialize innovation efficiently, reduce commercialization costs, access global markets and collaborate with industrial partners.

For universities, licensing is a central mechanism for transforming research into real-world impact.

Licensing may involve different forms of intellectual property. For example: patents, software, trademarks, databases, know-how, trade secrets, copyrighted materials, AI algorithms, or biotechnology inventions.

Common licensing models

1. Exclusive licensing

An exclusive license grants rights to only one licensee. The licensor cannot grant the same rights to other parties within the agreed scope.

Exclusive licenses are common in pharmaceuticals, biotechnology, deep-tech startups or medical devices. These industries often require high investment, long development timelines, and regulatory approval.

2. Non-exclusive licensing

A non-exclusive license allows multiple licensees to use the same technology simultaneously.

The owner may continue licensing the technology to additional organizations.

3. Field-limited licensing

Field-limited licensing restricts use of the technology to specific application areas. For example:

A university licenses an AI algorithm: to one company for healthcare applications, to another company for industrial automation. Both companies may legally use the technology within separate fields.

4. Territorial licensing

Territorial licensing limits commercialization rights to specific geographic regions. For example: A company receives rights to commercialize a technology in Europe, but not in North America or Asia.

5. Time-limited licensing

Time-limited licenses grant commercialization rights for a defined period. After expiration:

rights may return to the licensor, agreements may be renegotiated. Time-limited agreements: reduce long-term risk, encourage performance, support commercialization flexibility.

Emerging trends in licensing

Technology licensing is evolving rapidly. Important trends are: AI-driven licensing analytics, platform-based licensing, open innovation ecosystems, global startup collaboration, sustainability-oriented licensing.

Reflection questions:

1. What are the advantages of exclusive licensing?
2. Why might universities prefer licensing over startup creation?
3. What risks arise in international licensing agreements?
4. Should universities use humanitarian licensing for healthcare technologies?

2. Exclusive vs Non-Exclusive Licensing

Licensing strategy in technology commercialization

One of the most important decisions in technology transfer and commercialization is choosing the appropriate licensing model. The selected licensing strategy influences: commercialization speed, market access, investor interest, revenue generation, competitive positioning, long-term innovation impact. Two of the most common licensing approaches are exclusive licensing, non-exclusive licensing.

Exclusive licensing

Exclusive licensing grants commercialization rights to only one licensee within the agreed scope.

The licensor cannot:

- license the same rights to others,
- compete directly within the licensed field,
- authorize additional partners for the same territory or application area.

The licensee receives privileged commercial access to the technology.

Advantages of exclusive licensing:

- exclusive rights provide strong incentives for commercialization. Companies are more willing to invest when competitors cannot immediately access the same technology.
- exclusivity may encourage aggressive product development, large-scale marketing, infrastructure investment, international expansion.

- exclusive licensing often attracts venture capital, pharmaceutical investment, industrial partnerships. Investors prefer exclusivity because it reduces market competition, increases potential profitability, strengthens competitive advantage.
- exclusive agreements may generate larger upfront payments, higher milestone payments, substantial royalty income.
- exclusive technologies may become highly valuable when they solve major market problems, create technological differentiation, establish market leadership.

Risks of exclusive licensing:

- dependence on a single commercialization partner. If the licensee lacks resources, changes strategy, experiences financial difficulties, abandons development, the technology may never reach the market.
- reduced flexibility, exclusive licensing limits the licensor's ability to pursue alternative partnerships, diversify commercialization channels, adapt quickly to changing markets.
- long-term exclusivity may become restrictive.
- risk of underutilization - some companies acquire exclusive rights primarily to block competitors, control strategic technologies, delay market entry, which may reduce innovation diffusion.
- exclusive agreements are often highly negotiated because they involve valuable market rights, major financial commitments, long-term strategic consequences.

Non-exclusive licensing

Non-exclusive licensing allows multiple organizations to use the same technology simultaneously.

The licensor retains the right to:

- license additional companies,
- use the technology independently,
- commercialize through multiple channels.

Non-exclusive models are commonly used when:

- technologies are broadly applicable,
- development costs are lower,
- rapid diffusion is beneficial,
- interoperability is important.

This model promotes wider access and broader market participation.

Advantages of non-exclusive licensing:

- possibility of broader market penetration- multiple companies can commercialize the same innovation simultaneously.

- diversified revenue streams - revenue comes from multiple licensees rather than a single company. This reduces dependency and commercial risk. If one company underperforms, others may still generate revenue.
- lower dependency - non-exclusive licensing avoids excessive reliance on one commercialization partner. This creates greater flexibility, broader ecosystem participation, increased resilience.
- faster technology diffusion - non-exclusive models may support educational access open innovation, industry-wide adoption.

Risks of non-exclusive licensing:

- lower licensing fees - because exclusivity is not provided, individual licensees may pay lower upfront fees, smaller royalties, reduced milestone payments.
- increased competition - multiple licensees may compete directly using similar technology. It may reduce market differentiation, weaken competitive advantage, lower profitability for licensees.
- reduced investment incentives - some companies may hesitate to invest heavily when competitors can access similar technologies. This is particularly important in sectors requiring: expensive regulatory approval, high infrastructure investment.

Differences:

Factor	Exclusive licencing	Non-exclusive licencing
number of licencees	one	multiple
commercial incentive	very strong	moderate
market competition	limited	higher
revenue structure	potentially higher per agreement	diversified across agreements
commercial risk	higher dependancy	lower dependancy
technology diffusion	often stronger	variable
flexibility	lower	higher

Strategic considerations when choosing a licensing model:

- technology complexity - highly complex technologies often require exclusive investment, dedicated development, strong commercialization commitment. Simple or scalable technologies may benefit from broad licensing;
- market structure - exclusive market leadership while others benefit from open ecosystems, interoperability, widespread adoption;
- regulatory costs - industries requiring clinical trials, certification or extensive compliance often rely on exclusivity to justify investment;
- innovation goals - organizations may prioritize revenue maximization, social impact, broad accessibility, startup creation.

Universities prefer exclusive licensing when:

- technologies require heavy investment,
- startups need investor protection,
- commercialization risk is high.

Universities prefer non-exclusive licensing when:

- educational technologies,
- research tools,
- socially beneficial innovations,
- standards-based technologies.

Reflection question:

Which licensing model would be more suitable for educational software?

Consider accessibility, affordability, market competition, educational impact, and commercialization incentives.

Additional reflection questions:

1. Why do investors often prefer exclusive licensing?
2. What are the risks of relying on one commercialization partner?
3. When might non-exclusive licensing create greater societal impact? .

3. Royalties, Equity, and Financial Models

Licensing agreements often include multiple revenue mechanisms:

1. Upfront payments

Upfront payments are initial fees paid when the agreement is signed. They compensate the licensor for prior research, patent costs, technology development.

Advantages: upfront payments provide immediate revenue and reduce early commercialization risks.

2. Milestone payments

Milestone payments are triggered when predefined development goals are achieved. Common milestones: prototype completion, regulatory approval, clinical trials, market launch, sales targets.

Advantages: milestone system align incentives, distribute risk and encourage active commercialization.

3. Royalties

Royalties are recurring payments based on sales revenue, product units, licensing income. Royalty rates may depend on market size, exclusivity, industry sector, development stage. The licensee commercializes the technology and pays the licensor a percentage of generated revenue.

Common royalty models:

- percentage of sales
- fixed per-unit fees
- tiered royalty structures

Advantages of royalties:

- long-term revenue generation

Royalties may provide continuous income for many years. Successful technologies can generate: stable institutional revenue, reinvestment opportunities, research funding.

- alignment of interests

Both parties benefit from commercialization success. The licensor is incentivized to support: technology improvement, partnership development, market expansion.

- lower initial financial burden

Royalties reduce upfront costs for startups and companies. This may facilitate: early-stage commercialization, startup participation, innovation diffusion.

Risks of royalties:

- revenue uncertainty

Royalties depend on market success. If commercialization fails revenues may remain minimal, patent investments may not be recovered;

- monitoring challenges

Licensors must monitor sales reporting, accounting transparency and sublicensing activity. Auditing rights are therefore often included in agreements;

- long commercialization timelines

Some sectors, especially biotechnology and pharmaceuticals, may require years of development, clinical trials, regulatory approval. Royalty income may therefore be delayed significantly.

4. Sublicensing income

Some agreements allow the licensee to grant rights to additional third parties. This is known as sublicensing. The original licensor may receive a percentage of sublicensing income, milestone fees or additional royalties.

5. Equity ownership

Technology owners often choose between licensing technologies and creating start-ups.

Advantages of licencing: lower financial risk, faster commercialization, access to established companies;

Advantages of start-ups: greater control, higher potential returns, direct entrepreneurial involvement.

Equity means ownership shares in a company. Instead of receiving immediate licensing payments, universities or inventors may receive startup shares, ownership stakes, stock options.

Equity models are especially common in spin-offs, university startups, deep-tech innovation.

Early-stage startups often have limited cash, high technological potential, uncertain market outcomes. Accepting equity allows universities to support startup formation, participate in future growth, share commercialization risk.

Advantages:

If the startup succeeds, equity may become extremely valuable. Some university spin-offs generate significant financial return, regional economic growth and major societal impact.

Risks:

- high commercial risk, most startups fail or struggle commercially, equity may ultimately become worthless;
- financial may require many years
- conflict-of-interest concerns - University ownership in startups may create governance conflicts, research-bias concerns, commercialization pressure. Institutions therefore require transparency, conflict-management policies and independent oversight.

Reflection questions

1. Why might universities accept equity instead of royalties?
2. What are the risks of relying only on royalty income?

4. Negotiation Strategies in Technology Transfer

Commercial negotiation in innovation ecosystems

Technology transfer is not only a legal or scientific process it is also a strategic negotiation process.

Commercialization negotiations determine how:

- intellectual property is used,
- revenues are distributed,

- risks are allocated,
- partnerships are structured,
- innovation reaches the market.

Technology transfer negotiations often involve multiple stakeholders with different goals, expectations, and priorities.

Successful negotiation therefore requires balancing:

- university interests,
- inventor incentives,
- company profitability,
- long-term collaboration,
- societal impact.

Effective negotiation helps to build trust, reduce conflict, accelerate commercialization, attract investment, establish sustainable partnerships.

Poor negotiation may lead to failed agreements, legal disputes, commercialization delays, and damaged relationships.

Different interests

The Parties usually present different interests.

Universities typically seek to:

- protect intellectual property,
- generate commercialization revenue,
- preserve academic freedom,
- maintain research integrity.

Technology Transfer Offices negotiate on behalf of universities.

Researchers and inventors prioritize:

- recognition,
- publication,
- startup opportunities,
- financial participation,
- scientific impact.
- long-term collaboration,
- freedom to continue research.

Companies and investors focus on:

- profitability,
- competitive advantage,
- market exclusivity,

- commercialization speed,
- investment protection.

Governments and funding agencies may involve additional expectations when it comes to publicly funded projects

- public benefit,
- sustainability,
- open access,
- responsible innovation.

Important Negotiation Topics

Technology-transfer negotiations typically address multiple strategic issues.

1. Licensing fees

Negotiations often determine initial licensing fees, patent reimbursement, access costs, royalty percentages, minimum payments, tiered royalty systems, payment schedules.

2. Exclusivity

Exclusive rights may attract investors, justify commercialization investment, strengthen market position but also reduce flexibility. Non-exclusive licensing broadens market access, supports wider adoption and diversifies revenue. Negotiators must determine which approach best supports commercialization goals.

3. Publication rights

Agreements may establish publication-review periods, temporary embargoes, confidential-information screening.

4. Performance milestones

Licensors often include obligations requiring licensees to actively commercialize technologies such as development deadlines, minimum sales targets, regulatory milestones. These provisions prevent technologies from remaining unused.

5. Ownership of improvements

Commercialized technologies are often further improved after licensing. Negotiators must determine who owns modifications, derivative inventions, whether improvements are automatically licensed.

Effective negotiation skills

Technology-transfer professionals require multidisciplinary negotiation skills.

1. Communication skills

Clear communication - negotiators must explain technical concepts, legal structures and commercialization strategy

Active listening – negotiators should understand stakeholder priorities, identify hidden concerns, recognize strategic interests.

Trust building - long-term commercialization partnerships depend heavily on trust and transparency. Relationship quality often influences negotiation success as much as legal structure.

Value-based communication - technology should be described using the language of value and benefits rather than technical features. For instance: “Our system uses a convolutional neural network with optimized image segmentation” (technical) vs “Our technology improves early cancer detection accuracy and reduces diagnostic time for hospitals” (value-based).

2. Business understanding

Technology transfer requires understanding market economics, startup dynamics, investor expectations and commercialization models. Without business understanding, negotiations may become unrealistic or commercially unattractive.

3. Market knowledge

Successful negotiators analyse customer demand, competition, industry trends, regulatory barriers.

4. Legal awareness

Negotiators must understand intellectual-property law, licensing structures or confidentiality agreements. Legal awareness reduces compliance risk, contractual disputes and commercialization uncertainty.

5. Relationship management

Technology transfer often involves long-term collaboration. Strong relationship-management skills support conflict resolution, partnership sustainability and strategic alignment. Professional relationships frequently continue beyond a single agreement.

Negotiation preparation

Successful negotiation begins long before formal discussions. TTOs often prepare market analysis, patent evaluation, valuation studies, competitor analysis, commercialization forecasts.

Negotiation styles

Different negotiation approaches may be used depending on: relationship goals, strategic importance and market conditions.

- Competitive negotiation - focuses on maximizing advantage, protecting bargaining position, and securing financial return.
- Collaborative negotiation – emphasizes long-term partnership, shared value creation, mutual benefit and trust. Technology transfer increasingly favors collaborative approaches because commercialization often requires ongoing cooperation.

Negotiation in startups and spin-offs

Startup negotiations often involve equity allocation, founder roles, investor rights, IP licensing, and governance structures.

AI and digital technology negotiations:

AI and digital technology commercialization introduces additional negotiation challenges, such as access to training datasets, cloud infrastructure rights, software updates, algorithm transparency and cybersecurity responsibilities.

Digital business models increasingly rely on subscription structures, SaaS agreements, API licensing.

Ethical considerations in negotiations:

Technology-transfer negotiation raises important ethical questions. For example:

- Should universities maximize profit from publicly funded research?
- How should life-saving technologies be priced?
- Should commercialization prioritize societal access?

Reflection questions:

1. Why are publication rights often sensitive in university–industry negotiation?
2. How can milestone obligations improve commercialization outcomes?
3. Why is relationship management important in long-term innovation partnerships?
4. Should universities prioritize societal impact over licensing revenue?

5. Freedom to Operate (FTO)

What is Freedom-to-Operate?

Freedom-to-Operate (FTO) analysis evaluates whether a product, technology, or process can be commercially developed, manufactured, used, or sold without infringing existing intellectual-property rights owned by others. For example: A startup patents an innovative wearable-health sensor. However wireless communication technology, battery systems, data-processing algorithms used within the product may already be patented by other companies.

The startup therefore still requires FTO analysis before commercialization.

FTO is one of the most important legal and strategic assessments in technology transfer, startup development, product commercialization and investment evaluation.

An organization may own patents for its own invention while still infringing patents owned by other parties. For this reason, patent ownership alone does not guarantee freedom to commercialize. Commercialization without proper FTO analysis may expose organizations to patent litigation, financial damages, injunctions, product recalls, commercialization delays and investor concerns. It is therefore a critical component of legal risk management and commercialization strategy, FTO aims to identify legal obstacles, reduce infringement risk, support market-entry planning, guide licensing strategy, improve commercialization decisions. It also helps organizations determine where commercialization is safest, which markets create legal risk, whether additional IP protection is needed.

FTO stages:

1. Patent searching

FTO usually begin with searching existing patents potentially relevant to the technology. Common patent databases include: [Google Patents](#), [Espacenet](#), [WIPO Patentscope](#). Researcher may analyse keywords, patent classifications, inventors, competitors sand technological features.

2. Legal analysis

- whether proposed technology falls within protected claim. In some jurisdictions, infringement may occur even if technologies are not identical. Courts may evaluate whether technologies perform substantially similar functions, in substantially similar ways (doctrine of equivalents)
- geographic coverage – patent is territorial right
- maintenance status - expired patents may often be used freely.

3. Risk assessment

Organizations assess probability of infringement, likelihood of litigation, commercial impact, strategic importance of identified patents.

4. Strategic recommendations

After analysis, organizations develop commercialization strategies. If important patents are identified, organizations may negotiate licenses, cross-licensing agreements or partnerships. Engineers may modify technologies to avoid infringing patent claims. This is called designing around patents.

In some cases, organizations purchase patents, acquire companies, build defensive IP portfolios.

FTO in startups

Startups are especially vulnerable to infringement risk because they often operate with limited resources, commercialize rapidly and lack extensive legal infrastructure. Strong FTO analysis helps startups to attract investors, avoid litigation, and improve market strategy.

Patent thickets

A patent thicket is a dense network of overlapping patents covering related technologies. Patent thickets are common in telecommunications, semiconductors, biotechnology or AI ecosystems. Navigating patent thickets may require multiple licenses, strategic partnerships, cross-licensing agreements.

Open source and FTO

Open-source technologies may reduce some commercialization barriers but create others. Organizations must evaluate licensing obligations, copyleft provisions, derivative-work requirements.

International FTO challenges

Global commercialization creates additional complexity. Patent systems vary regarding: software patentability, enforcement, litigation standards, claim interpretation.

Practical example

A startup develops wearable health technology using biosensors, wireless communication and AI-based analytics. Before commercialization, the startup conducts FTO analysis. The analysis identifies: existing sensor patents, wireless-transmission patents and software licensing obligations. The company responds by:

- licensing critical technologies,
- modifying product architecture,
- adjusting market-entry strategy.

Best practices for FTO

Effective FTO strategy includes:

- early patent searching,
- continuous monitoring,
- collaboration with patent attorneys,
- integration with commercialization planning,
- international legal analysis.

FTO should not be treated as a one-time activity. Technology landscapes evolve continuously.

Reflection questions:

1. Why does owning a patent not guarantee commercialization freedom?
2. How can FTO improve investor confidence?
3. What industries face the highest FTO complexity?
4. Should patent systems be simplified to reduce commercialization barriers?

6. From Research to Market

The Innovation-to-Market Pathway

Technology commercialization usually follows multiple interconnected stages.

Although the process is rarely perfectly linear, several common stages appear in most innovation journeys.

1. Scientific discovery

Commercialization begins with scientific discovery or technological invention. Innovations may emerge from basic research, applied research, interdisciplinary collaboration, industrial partnerships, student projects, laboratory experimentation.

2. Proof-of-Concept

A proof-of-concept (PoC) demonstrates that a scientific idea can function in practice. At this stage researcher evaluate: technical feasibility, scientific validity and potential applications.

Proof-of-concept reduces uncertainty and helps determine whether further development is justified. Investors and Technology Transfer Offices often require PoC evidence before supporting commercialization.

3. Prototype Development

Prototype development transforms early concepts into working systems or products. Examples include software prototypes, medical-device prototypes, laboratory-scale technologies, demonstration platforms.

Prototypes help to test functionality, identify design problems, demonstrate value, attract partners and investors.

Prototype development is usually iterative. Teams repeatedly test, improve, redesign and optimize the technology.

4. Validation and testing

Validation evaluates whether the technology performs reliably under realistic conditions.

Types of validation:

- technical validation - performance testing, engineering analysis, software verification.
- clinical validation - medical trials, healthcare safety evaluation.
- market validation - customer testing, user feedback, pilot deployment.

Validation helps to reduce commercialization risk, improve investor confidence, support regulatory approval and identify market fit.

5. Intellectual property protection

Organizations evaluate patentability, trade-secret protection, copyright, trademarks, etc.

IP protection may create competitive advantage, attract investors, support licensing and increase startup valuation.

6. Market analysis

Technology alone does not guarantee market success. Commercialization teams evaluate: customer needs, industry trends, competition, pricing models, regulatory barriers and scalability.

For example:

- Who are the customers?
- What problem does the technology solve?
- Is there sufficient market demand?
- What competing technologies exist?
- What is the business model?

A technology must address a meaningful market need. Lack of market fit is one of the most common reasons startups fail.

7. Funding acquisition

Commercialization often requires significant financial resources. Funding may support prototype development, patent filing, clinical testing, regulatory approval, manufacturing, and market launch. Common funding sources are:

public grants (Horizon Europe, national innovation programs, research grants),

venture capital (funding in exchange for equity ownership, commercialization potential),

angel investors (usually individual investors)

corporate partnerships (strategic investment, co-development, licensing agreements)

8. Licensing or startup creation

Organizations must decide how the technology will enter the market. The technology may be licensed to the existing companies, industrial partners or multinational corporations.

Advantages: lower operational risk, faster market access, established distribution channels.

On the other hand, researchers may establish startups to commercialize technologies independently. Advantages: greater control, higher growth potential, entrepreneurial opportunity.

The choice depends on market structure, investment requirements, regulatory complexity, founder experience and scalability.

9. Market entry

Market entry involves product launch, customer acquisition, manufacturing scale-up, distribution and regulatory compliance.

10. Scaling challenges

Commercial deployment often requires operational growth, quality control, customer support,

international expansion. Scaling is frequently one of the most difficult commercialization stages.

Technology Readiness Levels (TRLs)

Technology Readiness Levels (TRLs) measure the maturity of a technology.

TRL frameworks help organizations evaluate: development progress, commercialization readiness, and investment risk.

Lower TRLs (1–3)

Early-stage research and conceptual exploration. Activities include:

- basic scientific research,
- theoretical analysis,
- proof-of-concept studies.

Medium TRLs (4–6)

Technology validation and prototype development. Activities include:

- laboratory testing,
- pilot systems,
- early validation.

Higher TRLs (7–9)

Technologies close to commercialization. Activities include:

- operational testing,
- industrial deployment,
- market-ready systems.

TRLs help investors to assess risk, universities to evaluate commercialization potential, governments to allocate funding and companies to plan development strategy.

Commercialization challenges

1. Insufficient funding

Many innovations fail because organizations lack resources for development, testing, scaling, or regulatory approval. Deep-tech sectors may require extremely large investments.

2. Regulatory barriers

Commercialization often requires certification, clinical approval, cybersecurity compliance, environmental assessment. Regulatory delays may significantly slow market entry.

3. Lack of market fit

Technologies sometimes solve problems that customers do not prioritize. Without clear market demand adoption may remain limited, investment may decline.

4. Scaling difficulties

A prototype may function successfully in a laboratory but fail during industrial production, global deployment, mass manufacturing.

Responsible innovation

Responsible commercialization integrates: ethics, sustainability, transparency, inclusiveness, and societal benefit. Innovation success increasingly depends not only on profitability but also on public trust, social impact and regulatory alignment.

Emerging trends in commercialization

Modern commercialization increasingly involves AI-assisted innovation, digital-health ecosystems, sustainability-driven investment, global startup collaboration, open innovation platforms, deep-tech accelerators. Innovation ecosystems continue evolving rapidly.

Reflection questions:

1. Why do many technologies fail before reaching the market?
2. How do TRLs help investors and commercialization teams?
3. What commercialization challenges are most difficult for startups?
4. Should universities prioritize commercialization or open science?

7. Startup and spin-off creation

Spin-off

A spin-off is a company established to commercialize technologies, inventions, or know-how developed within a university or research institution.

Spin-offs are usually founded by researchers, professors, students, TTOs, external entrepreneurs, investors.

A spin-off specifically originates from: academic research, university laboratories, publicly funded innovation, institutional intellectual property.

Spin-offs therefore often maintain strong relationships with universities, researchers, research infrastructure.

Startup

A startup is a newly established company seeking scalable and innovative business opportunities. Startups may emerge from industry, entrepreneurship, independent innovation, universities.

Why Universities Support Spin-Offs

Universities increasingly encourage entrepreneurial activity because commercialization creates multiple forms of value. University spin-offs contribute to job creation, regional economic growth, industrial innovation, high-technology sectors. Successful spin-offs may become: major employers, international companies, drivers of regional competitiveness.

Why researchers create spin-offs and startups?

It may generate equity growth, licensing income, acquisition opportunities. Researchers may choose spin-off or startup creation because it offers greater control, entrepreneurial opportunity, long-term value creation, direct societal impact. Researchers can actively shape: product development, commercialization strategy, market direction. Spin-offs allow researchers to translate scientific discoveries into: healthcare solutions, sustainable technologies, digital innovations, industrial applications.

Startup support mechanisms

Commercializing academic technologies is highly challenging. Universities therefore provide extensive support mechanisms:

1. TTOs

TTOs usually have section regarding academic entrepreneurship that is obliged to support researchers in startups and spinoffs creation. TTO usually gives mentoring and business connections.

2. Incubators

Some universities create incubators as a separate unit that should support early-stage startups by providing workspace, mentoring, business training, networking opportunities. Typical incubator services include office and laboratory space, legal support, commercialization guidance, startup education, investor preparation.

3. Accelerators

Accelerators are intensive programs helping startups grow rapidly. Programs often include: mentorship, investor access, business development, commercialization support. Accelerators help startups refine business models, validate markets, scale operations, prepare for investment.

Accelerators may be operated by universities, governments, corporations and venture-capital firms.

4. Mentorship

Startup founders often require guidance regarding: business strategy, commercialization, negotiation, leadership, fundraising. Mentors may include: entrepreneurs, investors, industry experts, experienced researchers, legal specialists. Strong mentorship significantly improves startup survival rates.

5. Seed funding

It means early financial support. Seed funding supports prototype development, patent filing, market validation, early hiring. Sources of seed funding: university commercialization funds, government innovation grants, angel investors, startup competitions. Many academic technologies fail because: proof-of-concept funding is insufficient, commercialization risk is high, private investors consider technologies too early-stage.

6. Venture capital

Venture-capital firms invest in startups with high-growth potential, scalable technologies, strong intellectual property. Investors evaluate: market opportunity, startup team, IP protection, commercialization strategy, scalability.

Researchers may struggle with investor communication, business terminology, commercialization timelines. Entrepreneurship training therefore becomes important.

7. Innovation hubs

Collaborative innovation spaces that connect startups, universities, corporations, investors, and public institutions. Innovation hubs strengthen regional innovation ecosystems.

Typical University contributions

Universities provide critical resources supporting spin-off development.

1. Laboratory access

Spin-offs often require specialized equipment, laboratories and research infrastructure. Universities may provide temporary laboratory access, shared facilities, technical testing environments.

2. Intellectual property licensing

Universities frequently license patents, software, know-how to startup companies. Licensing agreements define ownership, royalties, equity participation, commercialization obligations.

3. Technical expertise

Academic founders provide scientific expertise, technical knowledge, research capability. University researchers often remain advisors, consultants or scientific directors.

4. Networking support

Universities may connect startups with investors, industrial partners, government programs, international collaborators. Networking is often critical for funding, partnerships, market access.

University spin-off business models

Spin-offs may commercialize technologies through product sales, licensing, subscription services, SaaS platforms, consulting, AI-as-a-Service. Business models vary depending on technology type, market conditions and scalability.

Challenges for academic spin-offs

University spin-offs face numerous challenges:

1. Lack of business experience

Researchers often have strong scientific expertise, but limited entrepreneurial training, and commercialization knowledge.

2. Funding gaps

Deep-tech startups may require long development timelines, expensive validation, regulatory approval. Early-stage funding is often difficult to obtain.

3. Regulatory complexity

Commercialization may require medical approval, cybersecurity compliance, environmental certification, export-control compliance.

4. Market uncertainty

Technologies may fail commercially due to poor market fit, strong competition, pricing challenges.

5. Team building challenges

Successful startups require business leadership, operational management, marketing capability, and technical expertise. Building balanced interdisciplinary teams is difficult.

Technology Transfer Offices and Spin-Offs

TTOs often coordinate:

- IP protection,
- startup licensing,
- investor negotiation,
- commercialization planning.

TTOs increasingly function as:

- innovation facilitators,
- entrepreneurship advisors,
- commercialization strategists.

University equity in spin-offs

Universities often receive equity ownership, royalties, milestone payments in exchange for licensing university technology. This aligns institutional interests, spin-off success, commercialization incentives.

However, it may create conflicts of interests involving research objectivity, student supervision, commercialization pressure, use of university resources. Universities therefore establish disclosure requirements, ethics oversight, commercialization policies.

Practical example

A university research team develops an AI-based renewable-energy optimization platform. The University files patents, licenses the technology, supports startup formation. The spin-off receives incubator support, mentorship, venture-capital investment, laboratory access. The startup later expands internationally and collaborates with energy companies. This demonstrates how academic research may evolve into commercial innovation.

Reflection questions:

1. Why do many universities actively support entrepreneurship?
2. What challenges are unique to academic founders?
3. How can universities balance open science and commercialization?
4. Should universities prioritize societal impact over financial return?

8. Innovation Hubs and Accelerators

Innovation Hubs and Accelerators

Innovation success also depends heavily on support infrastructure, entrepreneurial ecosystems, funding access, collaboration networks and commercialization expertise. For this reason, modern innovation ecosystems increasingly rely on specialized support organizations such as innovation hubs, accelerators, incubators, science parks or technology-transfer centres. Innovation support organizations help reduce these barriers by providing infrastructure, expertise, mentorship, networks, commercialization guidance.

Core services provided by innovation hubs and accelerators

Most innovation hubs and accelerators provide integrated support systems.

1. Workspace

Physical infrastructure for innovation. Many startups and research teams initially lack office space, laboratories, technical infrastructure, meeting facilities. Innovation hubs often provide: co-working spaces, laboratories, engineering workshops, conference rooms, digital collaboration infrastructure.

2. Benefits of shared workspace

Shared environments encourage collaboration, networking, interdisciplinary interaction, knowledge exchange. Proximity to other startups and researchers often stimulates innovation.

3. Mentorship

Guidance from experienced experts Entrepreneurs frequently require support beyond technical expertise. Mentorship programs connect startups with experienced entrepreneur's investors, legal experts, commercialization specialists, industry professionals. Mentors help avoid common mistakes, refine business models, improve investor communication, strengthen commercialization strategy.

4. Networking

Innovation ecosystems depend heavily on relationships and collaboration. Innovation hubs facilitate networking between startups, corporations, universities, investors, public institutions, international partners. Strong professional networks improve funding opportunities, partnership development, customer acquisition, internationalization. Many commercialization opportunities emerge through ecosystem relationships.

5. Investor access

Technology transfer hubs frequently organize investor meetings, demo days, startup competitions, venture-capital events. Accelerators often help startups prepare business presentations, financial forecasts, commercialization strategies, investment pitches. Investor communication is a critical commercialization skill.

6. Prototyping facilities

Many technologies require hardware prototyping, software testing, engineering validation, manufacturing preparation. Innovation hubs may provide fabrication laboratories (FabLabs), 3D-printing facilities, electronics workshops, testing infrastructure. Prototyping support is especially valuable for robotics, medical devices, advanced manufacturing, renewable-energy systems.

7. Training and education

TT Hubs usually offer entrepreneurial skill development. Researchers often possess strong technical expertise but limited business experience. Innovation programs therefore provide training in: entrepreneurship, commercialization, IP management, fundraising, negotiation, startup leadership. Successful innovation also requires communication, team management, strategic thinking and international collaboration skills.

Benefits of strong innovation ecosystems

1. Improved funding access

Ecosystems connect innovators with grants, investors, venture capital, corporate partnerships. Funding opportunities become more visible and accessible.

2. Faster commercialization

Ecosystems reduce barriers by providing infrastructure, expertise, commercialization pathways. This may significantly shorten development timelines, market-entry processes.

3. Partnership opportunities

Innovation ecosystems facilitate interdisciplinary collaboration, industry partnerships, international cooperation. Partnerships often strengthen scalability, market access, technical development.

4. Internationalization

Global commercialization increasingly requires international networks, cross-border partnerships, market-entry support. Innovation hubs often help startups: access foreign markets, identify global partners, navigate international regulation.

University role in the ecosystem

University ecosystems often integrate Technology Transfer Offices, incubators, accelerators, science parks and investor networks.

Triple Helix Model

A widely used innovation concept is the Triple Helix Model involving universities, industry, government.

Challenges facing innovation ecosystems:

- unequal access to funding,
- regional innovation inequality,
- excessive bureaucracy,
- weak collaboration culture,
- limited commercialization expertise.

Measuring ecosystem success

Innovation ecosystems are often evaluated based on startup creation, patent activity, investment attraction, commercialization success, job creation or societal impact.

Reflection questions:

1. Why do startups benefit from innovation ecosystems?
2. How do accelerators differ from incubators?
3. Why are universities important actors in regional innovation ecosystems?
4. How can innovation ecosystems support sustainable development?

9. Commercialization Case Studies

Case Study 1: University Spin-off ARM Holdings (Cambridge)

Type: Spin-off + IP commercialization

Background:

Researchers at the University of Cambridge developed an innovative low-power microprocessor architecture in the 1980s.

Transfer mechanism:

- Creation of a university spin-off (ARM Holdings)
- University Technology Transfer Office (TTO) support
- Equity participation by the university

Outcome:

- ARM technology became the standard in mobile devices worldwide
- Significant financial returns and ecosystem development around Cambridge

Key lessons:

- Spin-offs are effective when technology has broad market potential
- Equity participation aligns incentives between the university and company
- Long-term impact may exceed initial licensing revenues

Case Study 2: Licensing Breakthrough – Google (Stanford University)

Type: Patent licensing + startup creation

Background:

The PageRank algorithm was developed by PhD students at Stanford University.

Transfer mechanism:

- Licensing of intellectual property to founders
- Formation of a startup (Google)

Outcome:

- Creation of a global technology leader
- Transformation of information retrieval and digital economy

Key lessons:

- Licensing can be a launchpad for startups
- Early-stage IP policies strongly influence commercialization pathways

Case Study 3: Public Research to Industry – Polymer Technology (CSIR-NCL)

Type: Licensing + know-how transfer

Background:

The National Chemical Laboratory developed hyper-branched polymer technology.

Transfer mechanism:

- Licensing to an industrial partner (SKYi Innovations)
- Transfer of process documentation and technical know-how
- Ongoing technical support

Outcome:

- Domestic production replaced imports
- Strengthened industrial capacity

Key lessons:

- Technology transfer is more than IP know-how is crucial
- Continuous technical support increases success probability
- Industrial policy (e.g., local production) can drive transfer

Case Study 4: Academic–Industry Collaboration – Medtronic Pacemaker

Type: Collaborative R&D → commercialization

Background:

Scientists at the University of Minnesota collaborated with Medtronic to develop a portable pacemaker.

Transfer mechanism:

- Joint development between university researchers and company
- Direct industrial application of research results

Outcome:

- Breakthrough in cardiac care technology
- Foundation for further innovations in medical devices

Key lessons:

- Collaboration is critical in highly regulated sectors
- Clinical applications often require industry integration early

Case Study 5: Biotechnology Tool – PCR Technology

Type: Industrial invention + licensing

Background:

Polymerase Chain Reaction (PCR) was developed, patented, and commercialized as a key molecular biology tool.

Transfer mechanism:

- Patent protection and licensing
- Strategic licensing policies and partnerships

Outcome:

- Widespread adoption in research and diagnostics
- Significant royalty revenues (approx. \$2 billion) [\[pmc.ncbi.nlm.nih.gov\]](https://pubmed.ncbi.nlm.nih.gov/)

Key lessons:

- Strong IP protection does not necessarily hinder diffusion
- Licensing flexibility can enable both commercialization and access

Case Study 6: National–Industrial Collaboration – AGH & KGHM (Poland)

Type: University–industry cooperation

Background:

AGH University collaborated with KGHM on mining technologies.

Transfer mechanism:

- Joint R&D projects
- Applied research implementation in industrial processes

Outcome:

- Increased operational efficiency

- Reduced production costs in mining

Key lessons:

- Continuous collaboration supports long-term innovation
- Applied research institutions play a key role in industrial sectors

Case Study 7: University–Biotech Collaboration – Jagiellonian University & Selvita

Type: Collaborative innovation (life sciences)

Background:

Research collaboration focused on developing oncology drugs. [\[akademia.pau.icz.gov.pl\]](https://akademia.pau.icz.gov.pl)

Transfer mechanism:

- Academic discoveries integrated into biotech pipelines
- Joint development and clinical research

Outcome:

- Drug candidates entering clinical phases
- Strengthening regional biotech ecosystem

Key lessons:

- Life sciences require long-term partnerships
- Technology transfer often extends into clinical/regulatory phases

Case Study 8: University Spin-off – OncoMark (Ireland)

Type: Academic spin-off (biotech/diagnostics)

Background:

OncoMark developed diagnostic tools for cancer based on university research.

Transfer mechanism:

- University-based patenting
- Spin-off creation
- Collaboration with clinical and industry partners

Outcome:

- Development of diagnostic tests for personalized medicine
- Integration into healthcare innovation ecosystem

Key lessons:

- Biotech spin-offs require close academia–clinic–industry integration
- Access to clinical validation is critical

Case Study 9: Medical Devices – Atlantic Therapeutics

Type: Spin-off + clinical innovation

Background:

Technology developed in a research setting led to neuromuscular stimulation devices.

Transfer mechanism:

- Patent protection
- Spin-off commercialization
- Regulatory approval process

Outcome:

- Marketed medical devices used globally
- Expansion into regulated international markets

Key lessons:

- Regulatory pathways are central in life sciences
- Technology transfer extends beyond invention into compliance and certification

Case Study 10: Materials Science – Cubicure (Austria)

Type: University spin-off (additive manufacturing)

Background:

Cubicure commercialized high-performance photopolymers for 3D printing.

Transfer mechanism:

- IP licensing from research institution
- Spin-off creation
- Industry partnerships

Outcome:

- Introduction of advanced materials in additive manufacturing
- Positioning in niche industrial markets

Key lessons:

- Deep-tech spin-offs often target specialized B2B markets
- Collaboration with industry accelerates scaling

Case Study 11: Measurement Technology – fos4X (Germany)

Type: Spin-off + industrial application

Background:

The technology originated from research on fibre optic sensors.

Transfer mechanism:

- Patent-based commercialization
- Collaboration with the wind energy industry

Outcome:

- Sensors used to monitor wind turbine performance
- Contribution to renewable energy innovation

Key lessons:

- Technology transfer supports sustainability transitions
- Industry-specific partnerships are essential

Case Study 12: Vaccines – ROTAVAC (Public–Private Partnership)

Type: Public-sector → industry transfer

Background:

A rotavirus vaccine was developed through public research institutions.

Transfer mechanism:

- Licensing to manufacturers
- Public–private partnership
- International funding and support

Outcome:

- Affordable vaccines delivered to large populations
- Public health impact at scale

Key lessons:

- Technology transfer can address global health challenges

- Pricing strategies and access policies matter

Case Study 13: Energy Technology Transfer (IEA Global Programmes)

Type: International technology diffusion

Background:

Energy technologies (e.g., efficiency solutions, renewables) are transferred globally through cooperation frameworks.

Transfer mechanism:

- International collaborations (OECD/IEA)
- Cross-border knowledge exchange
- Policy-supported deployment

Outcome:

- Increased adoption of sustainable energy technologies
- Global capacity building

Key lessons:

- Technology transfer can occur at system/global level
- Policy frameworks are critical

Case Study 14: Agricultural Innovation – Disease-Resistant Crops (CSU)

Type: University → agriculture sector

Background:

Research in plant sciences produced improved crop varieties.

Transfer mechanism:

- Patent protection
- Licensing to agricultural companies
- Field implementation

Outcome:

- Enhanced food security
- Adoption by farmers

Key lessons:

- Technology transfer in agriculture requires field validation
- Impact is often societal rather than purely financial

Case Study 15: Automotive Innovation – Blubrake (Italy)

Type: Spin-off (mechanical engineering)

Background:

Blubrake developed braking systems for electric bicycles based on research innovations.

Transfer mechanism:

- Patent commercialization
- Startup formation
- Industry integration

Outcome:

- Adoption in e-mobility solutions
- Contribution to urban mobility innovation

Key lessons:

- Emerging sectors (e.g., micromobility) create new transfer opportunities
- Fast prototyping and industrial design are key

Case Study 16: Imaging Technology – Perceive3D (Portugal)

Type: Medical imaging spin-off

Background:

Research in medical imaging led to advanced diagnostic solutions.

Transfer mechanism:

- IP licensing
- Creation of specialized startup
- Integration with healthcare providers

Outcome:

- Improved diagnostic capabilities
- Entry into medical technology markets

Key lessons:

- Digital health technologies require interoperability with existing systems
- Market entry depends on clinical partnerships

Lesson 3 Summary

In this lesson, learners explored:

- licensing strategies,
- commercialization financing,
- negotiation approaches,
- Freedom-to-Operate analysis,
- startup creation,
- innovation support ecosystems.

These concepts complete the foundation required to manage technology transfer and innovation commercialization.

Final Course Reflection Activity

Reflection questions

1. What are the most important challenges in technology transfer?
2. How can universities balance research openness and commercialization?
3. What role does ethics play in innovation ecosystems?
4. Which commercialization pathway would you choose for your own innovation and why?

Practical Assignment (Chapter 1)

Technology Transfer Agreement and Commercialization Decision

Background

A multidisciplinary university research team has developed an innovative medical technology called Smart-Heal AI. The system combines: wearable biosensors, artificial intelligence, cloud-based analytics and mobile-health applications to monitor chronic wounds in patients suffering from diabetes, vascular diseases and post-surgical complications.

The technology continuously collects physiological data from wound dressings and uses AI algorithms to detect infection risks, predict delayed healing, recommend treatment adjustments and alert healthcare professionals in real time.

The research project was funded through a national public-health innovation grant, university funding and collaboration with a regional hospital.

The research team includes biomedical engineers, AI specialists, physicians, software developers and PhD students.

Current situation

The prototype has successfully completed laboratory testing, initial clinical validation, pilot testing involving 50 patients.

The university's Technology Transfer Office (TTO) believes the innovation has strong commercialization potential because chronic wound care is a growing global healthcare problem, hospitals seek remote patient-monitoring solutions and AI-supported healthcare technologies are rapidly expanding. However, several challenges remain unresolved.

Emerging commercialization challenges

The research team must now decide on:

1. Intellectual property issues

- Should the wearable sensor technology be patented?
- Can the AI algorithms be protected?
- Should some elements remain trade secrets?
- Are there existing patents that may limit commercialization?

2. Ownership Issues

The project involved:

- university employees,
- students,
- hospital physicians,
- external software contractors.

Questions arise regarding:

- ownership of inventions,
- authorship of software,
- rights to clinical datasets.

3. Legal Agreements

Before further collaboration and commercialization, the parties may require:

- Non-Disclosure Agreements (NDAs),
- Material Transfer Agreements (MTAs),
- Data Processing Agreements,
- Joint Development Agreements (JDAs),
- clinical research agreements.

Commercialization Strategy

The university must decide whether to:

- license the technology to a large medical-device company,
- create a university spin-off startup,
- pursue a hybrid commercialization strategy.

Potential industry partners have already expressed interest in:

- exclusive licensing rights,
- international distribution agreements.

Ethical and Regulatory Concerns

The system processes sensitive patient health data, creating GDPR and AI-ethics concerns.

Potential ethical issues include:

- algorithmic bias,
- patient privacy,
- cybersecurity risks,
- unequal access to digital healthcare,
- transparency of AI recommendations.

The technology may also require:

- CE marking in the European Union,
- medical-device regulatory approval,
- clinical certification,
- cybersecurity compliance.

Additional Market Context

The global digital-health market is growing rapidly due to:

- aging populations,
- increasing chronic diseases,
- telemedicine adoption,
- healthcare workforce shortages.

Competitors already exist in:

- remote patient monitoring,
- AI diagnostics,
- wearable healthcare systems.

However, the SmartHeal AI system offers:

- lower operating costs,
- real-time predictive analytics,
- integration with hospital systems,
- improved mobility for patients.

Stakeholders

The commercialization ecosystem includes:

- the university research team,
- the Technology Transfer Office,
- regional hospitals,
- investors,
- public funding agencies,
- medical-device manufacturers,
- healthcare regulators,
- patients and patient organizations.

Student Tasks

Participants should work as a commercialization advisory team supporting the university and researchers.

Task 1 Intellectual Property Strategy

Analyze:

- which forms of IP protection are most appropriate,
- whether the invention satisfies patentability criteria,

- possible prior-art risks,
- ownership structure of the technology.

Participants should evaluate:

- patents,
- copyright,
- trademarks,
- trade secrets,
- database protection.

Task 2 Commercialization Strategy

Recommend the most appropriate commercialization pathway:

- exclusive licensing,
- non-exclusive licensing,
- startup/spin-off creation,
- strategic partnership.

Justify the recommendation based on:

- market conditions,
- scalability,
- funding needs,
- long-term growth potential.

Task 3 Legal and Regulatory Risk Assessment

Identify key legal risks including:

- patent infringement,
- GDPR compliance,
- AI regulation,
- clinical liability,
- cybersecurity obligations,
- export-control considerations.

Participants should propose:

- mitigation strategies,
- compliance mechanisms,
- governance procedures.

Task 4 Funding and Ecosystem Support Plan

Develop a commercialization-support strategy involving:

- university incubators,
- accelerators,
- venture capital,
- public innovation grants,
- European innovation programs,
- healthcare partnerships.

Participants should identify:

- potential funding stages,
- ecosystem actors,
- strategic partnerships.

Task 5 Ethical Analysis

Evaluate ethical implications related to:

- AI bias,
- patient consent,
- health-data ownership,
- transparency,
- accessibility,
- sustainability.

Participants should recommend:

- ethical governance mechanisms,
- responsible AI principles,
- data-protection safeguards.

Expected Deliverables

Participants should prepare:

1. IP Strategy

Including:

- patent recommendations,
- ownership analysis,
- protection strategy,
- prior-art evaluation.

2. Commercialization Strategy

Including:

- market-entry pathway,
- licensing/startup decision,

- business model,
- ecosystem partnerships.

3. Legal Risk Assessment

Including:

- compliance requirements,
- contractual recommendations,
- regulatory obligations,
- risk-mitigation plan.

4. Funding and Ecosystem Support Plan

Including:

- funding roadmap,
- investor strategy,
- innovation-support infrastructure,
- internationalization opportunities.

5. Ethical Analysis

Including:

- AI ethics considerations,
- GDPR implications,
- patient-rights analysis,
- societal-impact evaluation.

Chapter II: Measuring Technology Transfer Success: Economic Impact, KPIs and Evaluation

Course overview

This course develops the ability to define meaningful technology-transfer metrics, evaluate economic and social value, and communicate results through dashboards, executive briefs and impact narratives. The course provides participants with a comprehensive introduction to the measurement, evaluation, and performance assessment of technology transfer and innovation ecosystems. The course explores how universities, innovation hubs, startups, and research institutions evaluate the success and impact of commercialization activities through economic indicators, key performance indicators (KPIs), return on investment (ROI), and strategic reporting mechanisms. Participants will gain an understanding of institutional performance measurement frameworks and practical approaches for monitoring innovation outcomes and supporting evidence-based decision-making in technology transfer environments.

Course learning outcomes

By the end of this course, participants will be able to:

- Explain the role of KPIs and performance indicators in technology transfer ecosystems
- Understand economic and institutional impact measurement approaches
- Distinguish between quantitative and qualitative evaluation methods
- Analyze ROI, cost-benefit, and commercialization performance indicators
- Apply KPI frameworks for innovation hubs and startup ecosystems
- Design executive dashboards and reporting structures for technology transfer activities

Recommended LMS learning flow

- Build the measurement system in Lesson 1.
- Evaluate economic value in Lesson 2.
- Convert the results into dashboards and communication in Lesson 3.
- Complete the integrated case study as the practical assignment.

Lesson 1: Conceptualizing Technology Transfer Metrics

Lesson overview. The lesson establishes what should be measured in technology transfer and why metric design is a strategic choice. It covers indicator taxonomies, institutional and economic KPIs, the Triple Helix, commercialization pipelines, SROI and benchmarking.

Learning outcomes

- Define technology transfer and explain why measurement matters.
- Classify indicators using input-to-impact and leading/lagging perspectives.
- Define institutional and economic KPIs precisely.
- Explain the Triple Helix model and its measurement implications.
- Describe how commercialization can be measured along the pipeline.
- Explain SROI and recognize measurement gaming and Goodhart's law.

Core topics

- Technology-transfer metrics
- Innovation performance indicators
- Institutional and economic KPIs
- Triple Helix model
- Research commercialization pipeline
- Social Return on Investment (SROI)
- TTO performance evaluation
- Innovation ecosystem assessment
- Data collection and benchmarking

Learning activity / reflection

Select one technology-transfer objective and design three indicators: one leading indicator, one lagging indicator and one qualitative measure. Explain what decision each indicator supports.

Lesson summary

Good measurement is not about collecting the largest possible number of indicators. It is about choosing measures that are precise, decision-relevant and aligned with the purpose of technology transfer.

Lesson 1 at a Glance

Technology transfer turns research into use into products, companies, jobs, better policy and public benefit. Managing that translation well depends on measuring it well, and measuring it well is harder than it looks. This lesson builds the conceptual foundation for the whole course: it defines what technology transfer is, what we can meaningfully count, how to judge a technology transfer office (TTO), and how to value social as well as economic returns. Lesson 2 then asks what the economic outcomes are worth (ROI and economic impact); Lesson 3 asks how to report everything so it changes decisions.

The central message is that **a metric is a deliberate design choice, not a neutral fact**. Every indicator embeds a definition, a boundary and an assumption about what success means. Choose the wrong ones and a TTO can look excellent while doing little of value, or look weak while building exactly the capacity its region needs. Conceptualizing metrics well is the difference between measurement that guides an institution and measurement that merely decorates it.

Learning outcomes

By the end of Lesson 1, participants will be able to:

1. Define technology transfer and its channels, and explain why measurement matters.
2. Classify indicators using the inputs–impact taxonomy and the leading/lagging and quantitative/qualitative distinctions.
3. Define the core institutional and economic KPIs of technology transfer precisely.
4. Explain the Triple Helix model and its measurement implications.
5. Describe how research commercialization is measured along the pipeline.
6. Explain Social Return on Investment (SROI) and interpret an SROI ratio.

7. Evaluate a TTO's performance and recognize measurement gaming (Goodhart's law).
8. Assess a hub's maturity and design a sound data-collection and benchmarking approach.

How this lesson connects to the others

Lesson 1 defines and collects the indicators (and introduces SROI). **Lesson 2** converts the economic outcomes into value (ROI, IRR, cost–benefit, multipliers). **Lesson 3** turns the whole indicator set into dashboards, briefs and impact narratives. Where a term first appears it is collected in the Glossary at the end.

1.1 Introduction to Technology Transfer Metrics

Technology transfer (TT), often used interchangeably with *knowledge transfer* or *knowledge valorization*, is the process by which knowledge, skills, methods and intellectual property created in research move to organizations that can put them to practical use. It is deliberately broad: licensing a patent to a company is technology transfer, but so is a graduate carrying expertise into industry, a spin-off commercializing a discovery, or a research team advising a ministry on policy.

Because the term is broad, **measuring only one channel distorts the picture**. A TTO judged solely on license income will neglect the collaborative research, training and public-good transfer that often create more value for a region. The first discipline of conceptualizing metrics is to recognize the full set of channels through which transfer happens.

Channels of technology & knowledge transfer



This course measures all channels — not licensing income alone

Figure 1. The main channels of technology and knowledge transfer. A complete measurement system covers all of them, not licensing alone.

Where the field came from

The deliberate management of technology transfer is relatively young. In the United States the **Bayh–Dole Act of 1980** allowed universities to retain title to inventions arising from federally funded research, which created the incentive to set up offices to patent and license them; the modern technology transfer office is largely a product of that change. Europe followed along different paths, with national frameworks rather than a single statute, which is one reason European metrics are less standardized than US ones (a point that returns under benchmarking in Topic 1.9). Understanding this history matters for measurement because it explains why so much early data is about patents and licenses the activities the first offices were created to perform

and why broader channels such as collaborative research and mobility were measured later and less consistently.

A second conceptual root is the shift from a *linear model* of innovation (basic research leads tidily to applied research, then development, then a product) to an *interactive model* in which feedback runs in every direction and users, firms and policy shape research as much as the reverse. The linear model implied that measuring research inputs and patent outputs was enough. The interactive model, which the evidence now strongly favours, implies that we must also measure relationships, feedback and use which is why this lesson treats interaction indicators and ecosystem health as seriously as counts of patents.

Why measure at all?

Measurement serves five purposes, and being clear about which one is in play prevents most reporting errors later:

- **Management.** Allocating staff, budget and effort where they produce most value.
- **Accountability.** Demonstrating to government, funders and university leadership that resources are well used.
- **Improvement.** Learning which processes and policies work, and improving them over cycles.
- **Advocacy.** Making the case for continued investment in research and its translation.
- **Continuity.** Acting as institutional memory projects end, people move on and funding cycles rotate, but well-kept indicators keep an innovation visible and managed so it does not quietly disappear once a grant closes.

These purposes pull in different directions: metrics good for internal management (granular, timely) are rarely those good for external advocacy (aggregated, impact-focused). Recognizing the purpose first is what keeps a measurement system coherent, a theme completed in Lesson 3.

Knowledge check 1.1

- Define technology transfer in one sentence and name three channels other than licensing.
- Why does measuring only license income distort a TTO's contribution?
- Name the five purposes of measurement and give a TT example of each.

1.2 Innovation Performance Indicators

Indicators gain meaning from where they sit in the chain from resources invested to ultimate effect. A widely used European formulation, developed by the European Commission's Joint Research Centre with ASTP, classifies indicators as **inputs, activities, outputs, outcomes and impact**.¹

¹ European Commission Joint Research Centre with ASTP (Campbell et al., 2020): harmonized inputs/activities/outputs/outcomes/impact framework for knowledge-transfer metrics.

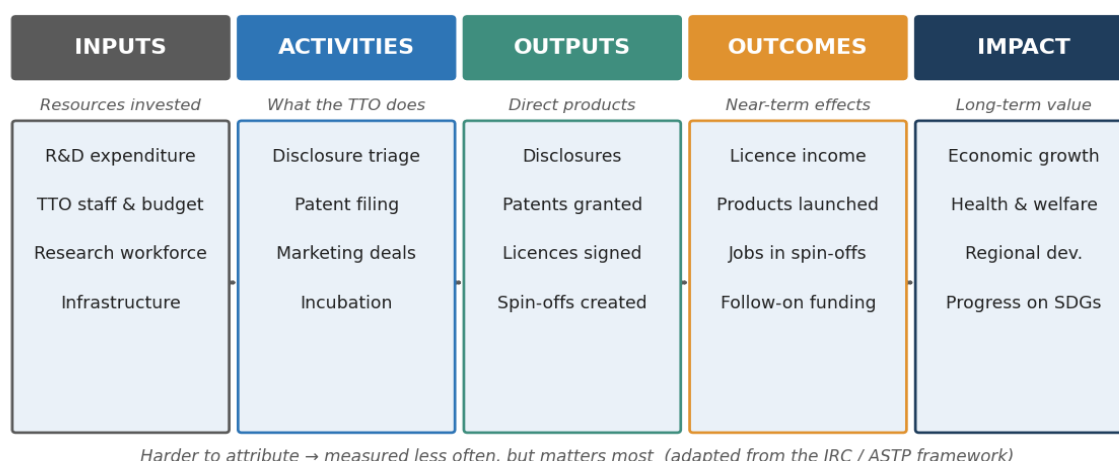


Figure 2. The inputs–activities–outputs–outcomes–impact taxonomy, with example indicators. Attribution becomes harder from left to right, which is why the most important categories are often the least measured.

- **Inputs** resources committed (research spend, TTO staff and budget, workforce, infrastructure).
- **Activities** what the TTO does (disclosure triage, patent filing, marketing, incubation).
- **Outputs** direct countable products (disclosures, patents, licenses, spin-offs).
- **Outcomes** near-term effects (license income, products launched, jobs, follow-on funding).
- **Impact** long-term value (economic growth, health and welfare, regional development, SDGs).

Two further distinctions cut across the taxonomy. The first is timing: **leading indicators** are early and controllable and predict future results (disclosures, conversion); **lagging indicators** confirm results after the fact (license income, surviving spin-offs). The second is form: **quantitative** indicators are numeric and comparable; **qualitative** indicators capture what numbers miss reputation, partnership depth, societal testimony.

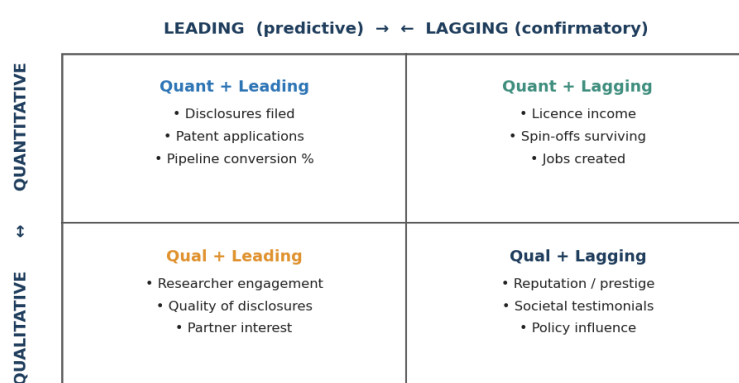


Figure 3. Indicators by timing (leading/lagging) and form (quantitative/qualitative). A healthy set draws from all four quadrants, not the top-left alone.

A common failure is to live entirely in the quantitative-lagging quadrant reporting license income and little else, and the **attribution gradient** reinforces it: as we move toward impact, figures matter more but are harder to attribute, so offices over-report easily counted outputs and under-report

hard-to-attribute impact. A balanced set of performance indicators deliberately populates all categories and both quadrants.

From raw counts to constructed indicators

A raw count rarely answers a management question on its own. Most useful indicators are **constructed** by combining a raw measure with a denominator or a baseline, and the choice of construction changes what the indicator means. Three constructions recur throughout technology transfer measurement:

- **Normalized indicators** divide a count by the resource that produced it disclosures per €1m of research expenditure, licenses per academic FTE so that a large and a small institution can be compared fairly. A raw disclosure count rewards size; a normalized one rewards productivity.
- **Ratio and conversion indicators** express progress between two stages the share of disclosures that become patents, or patents that become licenses and reveal where in the pipeline value is gained or lost.
- **Growth and trend indicators** express change over time rather than a level, which is the fairest way to judge a young or fast-changing hub (developed further in Lesson 3's trend analysis).

Constructing an indicator also forces three decisions that are easy to leave implicit and expensive to get wrong: the *counting unit* (do we count a patent family or each national filing?), the *time boundary* (the year of disclosure, of filing, or of grant?), and the *inclusion rule* (do co-owned inventions count fully, or in proportion to the institution's share?). Two analysts who answer these differently will report different numbers for the 'same' indicator, which is precisely why a documented definition (Topic 1.8) is indispensable.

Construction	Example	Best used to...
Raw count	Disclosures this year	Show absolute volume of activity
Normalized	Disclosures per 100 academic FTE	Compare institutions of different size
Conversion ratio	Licenses ÷ disclosures	Locate pipeline strength and loss
Growth rate	Year-on-year change in disclosures	Judge trajectory of a young hub
Composite index	Weighted blend of several KPIs	Summarize with care for a scorecard

Composite indices deserve a special caution. Blending several indicators into a single score (as some innovation rankings do) is attractive for communication but hides the weighting choices inside it, and a different but equally defensible set of weights can reorder the results. Where a composite is used, the weights should be published so the reader can see the judgement embedded in the number.

Knowledge check 1.2

- Place on the taxonomy: R&D spend, patents granted, jobs in spin-offs, license income, regional growth.
- Classify as leading/lagging and quant/qual: disclosures, license income, researcher engagement, reputation.
- Explain the attribution gradient and the reporting bias it creates.

1.3 Institutional and Economic KPIs

With the framework in place, we can define the core key performance indicators (KPIs) used across the sector. Precise, shared definitions matter enormously: as Lesson 3 shows, the most common cause of a discredited dashboard is two units counting the 'same' KPI differently. The table gives working definitions; the figure maps each KPI to the stage it measures.

KPI	What it measures	Category
Invention disclosures	New inventions formally reported by researchers	Output (leading)
Patent applications / grants	IP protection sought / secured	Output (leading)
Licenses & options executed	Agreements transferring rights to use IP	Output
License income	Revenue from licenses, royalties and fees	Outcome (lagging)
Spin-offs created	New companies formed to commercialize research	Output / outcome
Spin-off survival & jobs	Ventures still operating; employment created	Outcome (lagging)
Research/industry contracts	Collaborative and contract research agreements	Output
Pipeline conversion rate	Share of disclosures progressing to licenses	Activity (leading)
Deal cycle time	Time from negotiation start to signature	Activity (process)

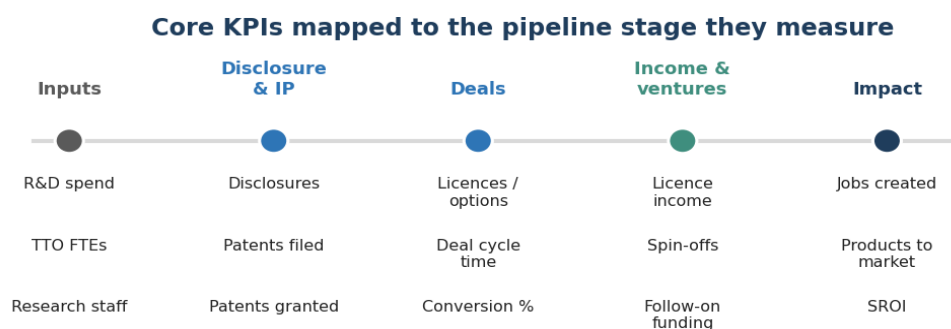


Figure 4. Core KPIs mapped to the pipeline stage they measure, from leading, controllable indicators to lagging, outcome indicators.

It is useful to separate **institutional KPIs** (how well the TTO and its processes perform disclosures, conversion, deal cycle time) from **economic KPIs** (the financial results those processes produce license income, follow-on investment, jobs). Both are needed: institutional KPIs are mostly leading and steer the office; economic KPIs are mostly lagging and demonstrate results.

Worked example: defining 'license income' precisely

Two faculties report 'license income': A reports €120k, B reports €95k. A looks stronger until definitions are checked.

- **Faculty A** includes €30k reimbursed patent costs and a €20k one-off signing fee.
- **Faculty B** reports only recurring royalties.

On a like-for-like basis A earned €70k and B €95k, the ranking reverses. A KPI without a documented definition is not comparable, even within one institution.

Reading a KPI critically

Each KPI carries strengths and blind spots, and a competent analyst reads both before trusting a number. The table below extends the core set with the question each KPI answers well and the trap it hides, which is the kind of judgement the rest of the course builds on.

KPI	Answers well	Hidden trap
Invention disclosures	Is research engagement growing?	Counts intent, not quality or value
Patents granted	Is protectable IP being secured?	Rewards legal activity over use
Licenses executed	Are rights reaching users?	One deal may dwarf the rest
License income	What financial return is realized?	Lumpy, lagging, highly skewed
Spin-offs created	Are new ventures forming?	Says nothing about survival
Conversion rate	How efficient is the pipeline?	Noisy year to year (cohort lag)
Contract research income	Is industry engaging the research base?	May crowd out riskier early work

Two further distinctions sharpen KPI use. An **efficiency KPI** relates output to the resource consumed (licenses per officer); an **effectiveness KPI** relates output to the mission (regional jobs created). A hub can be highly efficient at producing something of little value, so the two must be read together. And every KPI sits somewhere on a *controllability* spectrum: a TTO directly controls how many deals it markets, partly influences how many disclosures it receives, and barely controls whether a licensed product ultimately sells. Holding staff accountable for indicators they cannot control is a common and demotivating error.

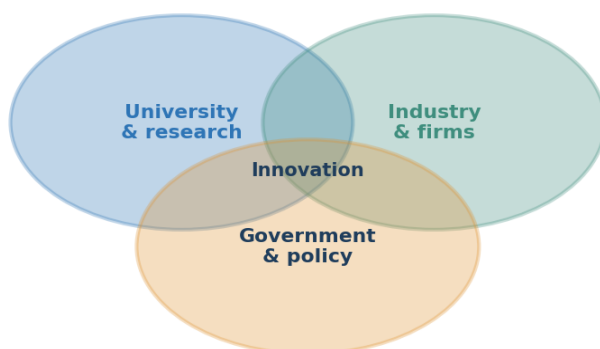
Knowledge check 1.3

- Define invention disclosure, license income and pipeline conversion rate.
- Distinguish an institutional KPI from an economic KPI and give one of each.
- Why must each KPI have a single documented definition before it is reported?

1.4 The Triple Helix Model

Indicators gain further meaning from the model of innovation they sit within. The most influential such model is the **Triple Helix** (Etzkowitz and Leydesdorff), which holds that innovation arises from the dynamic interaction of three spheres universities, industry and government, rather than from any one acting alone.

The Triple Helix and the innovation ecosystem



Metrics must capture interactions among the three spheres, not each in isolation

Figure 5. *The Triple Helix model. Innovation emerges where the three spheres overlap, which implies measuring interactions, not just the activity of each sphere in isolation.*

This carries a real measurement implication. If value is created in the *interactions* between spheres, then indicators of those interactions joint projects, co-publications with industry, mobility of people, shared facilities matter as much as any single actor's internal outputs. The broader **innovation ecosystem** view (Topic 1.8) extends this, adding investors, intermediaries, incubators and civil society, and treats the health of the whole system as the object of assessment.

From three helices to four, and what it means for measurement

The Triple Helix has been extended in response to a fair criticism: it can read as a top-down account in which three institutional elites drive innovation while the public receives it. The **Quadruple Helix** adds a fourth sphere civil society, users and the media and a *Quintuple Helix* adds the natural environment as a fifth. For a measurement course the debate matters less than its practical implication: the more spheres a model recognizes, the more the relevant indicators shift from counting one actor's outputs toward measuring **interactions and inclusion** public engagement, user co-creation, environmental outcomes which are exactly the indicators that are hardest to count and most often omitted.

Three families of interaction indicator follow directly from a helix view and are worth measuring deliberately:

- **Co-production indicators** co-publications with industry, jointly supervised doctorates, shared facilities and joint patents.
- **Mobility indicators** researcher secondments to firms, industry staff embedded in labs, graduate destinations.
- **Network indicators** the number, diversity and durability of partnerships, which signal the health of the relationships in which value is created.

The measurement lesson of the helix tradition is therefore consistent across all its versions: an institution that measures only its own internal outputs is, by the model's own logic, measuring the wrong thing, because the value is created in the spaces between the spheres.

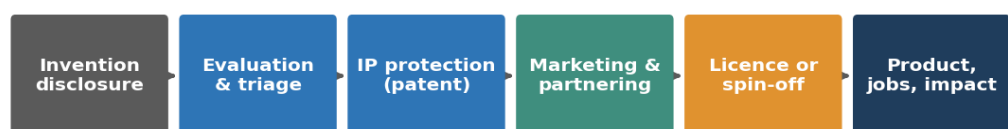
Knowledge check 1.4

- Name the three spheres of the Triple Helix and what the model claims about where innovation arises.

- What does the model imply we should measure that single-actor metrics miss?
- How does the innovation-ecosystem view extend the Triple Helix?

1.5 Measuring Research Commercialization

Commercialization is the route by which research outputs become marketable products, services or ventures chiefly through *licensing* (transferring rights to an existing company) and *spin-offs* (creating a new company). Measuring it means tracking a pipeline, not a single number.



Only ~1 in 4-5 disclosures is licensed

Each stage generates indicators — Lesson 1 defines them; Lesson 2 values the outcomes; Lesson 3 reports them

Figure 6. *The commercialization pipeline. Each stage generates indicators; Lesson 1 defines them, Lesson 2 values the outcomes, Lesson 3 reports them.*

Two features shape commercialization metrics. First, the pipeline is a **funnel**: only a minority of disclosures are protected, fewer are licensed, and fewer still generate significant income commonly only around one in four to five disclosures proceeds to a license, so *conversion between stages* matters as much as totals. Second, long time lags separate the stages, so a disclosure today may not show its value as a product for a decade.

A further structural fact must be built into expectations: commercialization returns are **highly skewed**. A small number of ‘home-run’ deals typically generate the large majority of license income, so the *average* deal tells you little about a portfolio. Lesson 2 returns to this skew with figures; for now, the point is simply that totals and averages can both mislead.

Technology readiness as a maturity measure

Where the pipeline shows *which stage* a technology has reached, the **Technology Readiness Level (TRL)** scale shows *how mature* it is on a 1–9 ladder, from basic research (1–3), through prototype (4–5) and validation (6–7), to operational deployment (8–9). Originally developed at NASA and now embedded in EU Horizon Europe calls, TRL has become a common language for describing how close a technology is to real-world use.²

²Technology Readiness Levels originated at NASA and are defined for research and innovation funding in the European Commission's Horizon Europe General Annexes (TRL 1–9).

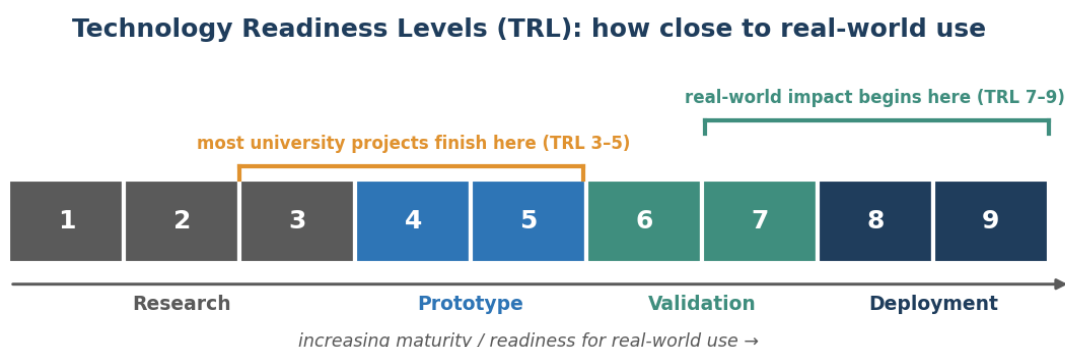


Figure 7. The Technology Readiness Level scale. Most university research finishes around TRL 3–5, but real-world impact typically begins only at TRL 7–9, so the gap a TTO must help close is visible on this ladder.

TRL is useful for measurement because it makes the **readiness gap** explicit: most university projects end at TRL 3–5, while adoption and impact begin at TRL 7–9. A commercialization indicator set should therefore track not just how many disclosures or licenses exist, but whether technologies are *advancing along the TRL ladder*, and a hub’s real job is often to fund and manage the crossing from prototype to deployment, the point at which innovations most frequently stall once project funding ends.

Boundary with Lessons 2 and 3

This topic measures commercialization activity and conversion. *Valuing* the outcomes licensing revenue analysis, ROI, patent-portfolio value, is Lesson 2; *reporting* them is Lesson 3.

Knowledge check 1.5

- Name the two principal commercialization routes and the difference between them.
- Why is conversion between pipeline stages as important to measure as totals?
- Why does the skew of licensing returns make the average deal a poor guide?

1.6 Social Return on Investment (SROI)

Much of the value created by technology transfer is social, not financial better treatments, a cleaner environment, skilled graduates, stronger regions. **Social Return on Investment (SROI)** is a framework for capturing that value by monetizing social outcomes and expressing them as a ratio to the investment that produced them. It extends conventional return measures (Lesson 2) to the public-mission value that most research institutions exist to create.

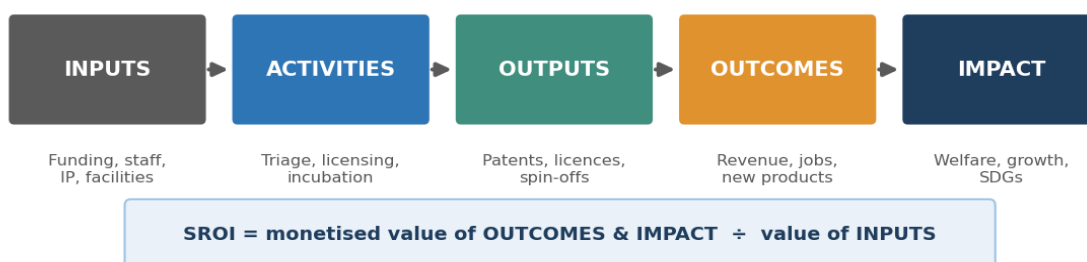


Figure 8. *SROI rests on a logic model: inputs lead through activities and outputs to outcomes and impact, which are monetized and divided by the value of the inputs.*

SROI is computed by following a logic model from inputs to impact, placing a monetary value (a 'financial proxy') on each significant social outcome, and dividing the total social value created by the investment made. An **SROI of 3.8**, for example, means that each euro invested generated an estimated €3.80 of social value. The headline ratio is intuitive and persuasive for non-specialist audiences; a reason it is introduced early in this course.

How an SROI is actually built

SROI is not a single formula but a disciplined process, usually described in six stages. Knowing the stages is what separates a credible ratio from a number pulled from the air.

1. Establish scope and stakeholders decide what is being measured and who is materially affected.
2. Map outcomes build the theory of change linking the activity to the changes stakeholders experience.
3. Evidence outcomes and give them a value find data that the outcomes occurred and attach a financial proxy to each.
4. Establish impact subtract what would have happened anyway (deadweight), what was displaced, and the share due to others (attribution).
5. Calculate the SROI ratio the present value of impact divided by the value of the inputs.
6. Report, use and embed disclose the assumptions and let the analysis inform decisions.

Four adjustments in stage four do the real analytical work, and an SROI that omits them will overstate value: **deadweight** (the outcome would have happened anyway), **displacement** (the activity merely moved an outcome from elsewhere), **attribution** (other actors caused part of it), and **drop-off** (the effect fades in later years). The honest SROI is almost always considerably lower than the naïve one, which is why transparency about these four is the mark of a trustworthy analysis.

Adjustment	Question it answers	Effect on the ratio
Deadweight	Would it have happened anyway?	Reduces
Displacement	Did it just move the outcome?	Reduces
Attribution	How much was due to others?	Reduces
Drop-off	Does the effect fade over time?	Reduces later years

Strengths and cautions

SROI's strength is that it makes otherwise invisible public value explicit and comparable. Its weakness is that the result depends entirely on the valuation assumptions, which outcomes are counted, what proxies are used, how much is discounted for what would have happened anyway (*deadweight*), and over how long. A credible SROI states its assumptions transparently; an undisclosed assumption turns a persuasive ratio into a credibility risk. SROI is best presented alongside a short, evidenced impact narrative rather than as a bare number, a point developed in Lesson 3.

Knowledge check 1.6

- What does SROI measure, and how is the ratio computed?

- Interpret an SROI of 3.8 and name the main caveat when reporting it.
- Why should SROI be paired with a narrative rather than presented as a bare number?

1.7 Technology Transfer Offices and Performance Evaluation

The technology transfers office (TTO) is the unit that manages commercialization on behalf of an institution. Understanding what it does is the basis for evaluating it fairly, and for choosing metrics that reflect its real contribution rather than just its easiest-to-count activity.

What a TTO does — and how its performance is judged

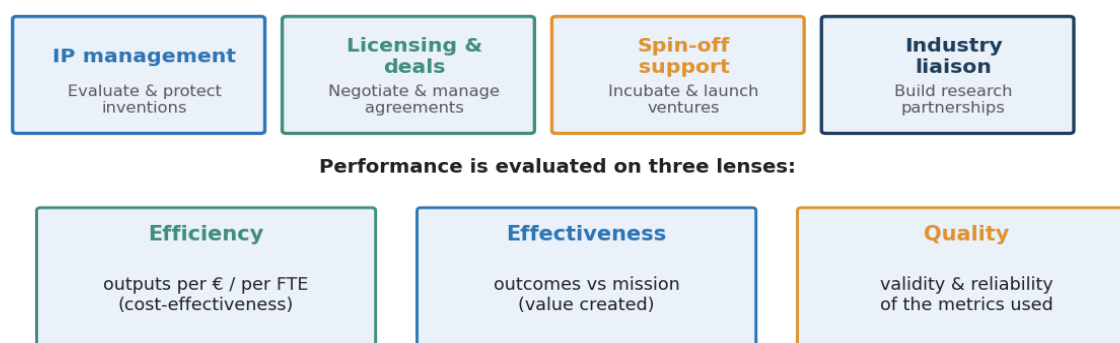


Figure 9. Core TTO functions and the three lenses through which performance is evaluated: efficiency, effectiveness and the quality of the metrics themselves.

A TTO's performance is judged on three lenses. **Efficiency** asks how much output it produces per euro and per staff member. **Effectiveness** asks whether it advances the institution's mission value created, not just activity counted. The third lens is the **quality of the metrics** themselves, which rests on two properties from measurement science.

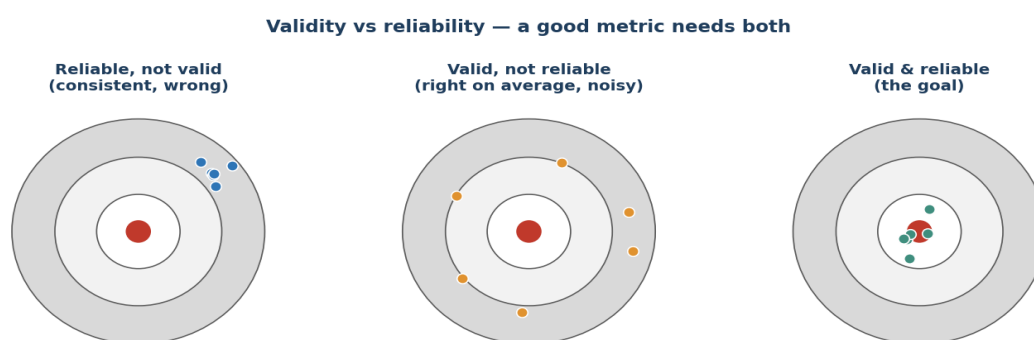


Figure 10. Validity versus reliability. A metric can be consistent but wrong, right on average but noisy, or, the goal both accurate and consistent.

Validity asks whether an indicator measures what we intend (does 'patents filed' capture innovation, or just legal activity?); **reliability** asks whether it measures consistently (would two officers count disclosures the same way?). A good TTO metric needs both. A useful screen is whether a KPI is **SMART** Specific, Measurable, Achievable, Relevant and Time-bound.

Designing a fair evaluation

Evaluating a TTO well means choosing not just metrics but an **evaluation design**, and three design questions shape whether the result is fair. The first is the *comparison*: is the office judged against its own past (a time-series), against peers (a benchmark), or against an explicit target? Each answers a different question, and using only one can mislead a hub improving fast against its own history may still lag its peers. The second is *formative versus summative*: a formative evaluation runs alongside the work to improve it, while a summative one judges it after the fact for accountability. Confusing the two using a learning exercise to allocate blame quickly destroys the honesty on which good measurement depends. The third is the *time horizon*: because returns lag by years, a one-year evaluation window will almost always make a developing office look weak.

Two further ideas raise the quality of an evaluation. **Triangulation** combines several imperfect indicators and qualitative evidence so that no single number carries the verdict; where quantitative and qualitative signals agree, confidence rises. And a **logic model** the explicit chain from inputs through activities and outputs to outcomes and impact lets an evaluator locate where performance is strong or weak rather than judging only the end result. A hub may have excellent inputs and activities but weak outcomes because of a market failure beyond its control, and a logic model makes that visible instead of penalizing the office for the gap.

The danger of gaming: Goodhart's law

Evaluating a TTO on a single number invites distortion. Goodhart's law warns that **when a measure becomes a target, it ceases to be a good measure**. Reward staff purely on patents filed and they will file low-value patents; judge them on disclosures and trivial ones appear. The defense is a balanced set of indicators, pairing quantity with quality, and revisiting metrics periodically.

Worked example: Goodhart's law in a TTO

A hub introduces a bonus for each patent filed. Filings double within a year, an apparent success. But the share of filings reaching a license collapses, maintenance costs rise, and officer time shifts from marketing deals to drafting low-value applications. Pairing filings with conversion rate and net IP cost would have exposed the problem at once.

Knowledge check 1.7

- Name the core functions of a TTO and the three lenses used to evaluate it.
- Define validity and reliability and give a TT example with one but not the other.
- State Goodhart's law and name two defenses against measurement gaming.

1.8 Innovation Ecosystem Assessment

Beyond individual KPIs and a single TTO, conceptualizing measurement includes assessing the **maturity** of a hub or innovation ecosystem as a whole. A maturity model places a hub on a developmental path and crucially implies which metrics and targets are appropriate at each stage.

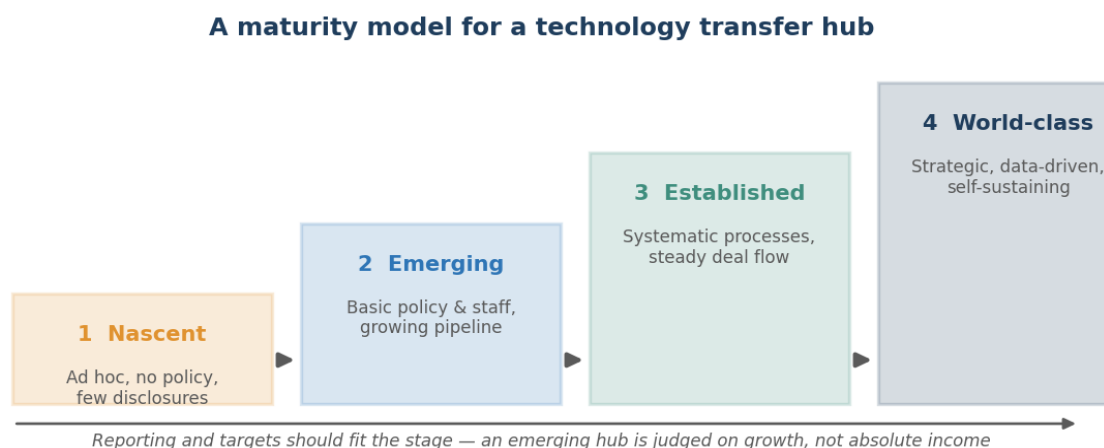


Figure 11. A maturity model for a technology transfer hub. The stage determines which indicators matter and what good performance looks like.

The practical payoff is that **assessment must fit maturity**. A nascent or emerging hub should be judged mainly on leading indicators and growth disclosure volume, researcher engagement, first partnerships, pipeline development, because lagging revenue is still small and volatile and says little about trajectory. An established or world-class hub can reasonably be held to outcome and impact targets. Applying a mature hub's scorecard to an emerging one is both demoralizing and analytically wrong; this returns, with figures, in Lesson 3.

Ecosystem assessment also looks beyond the institution to the wider system, the availability of investors and incubators, the strength of university–industry links, supportive policy and skilled people. A hub cannot be evaluated in isolation from the ecosystem it sits within.

What an ecosystem assessment actually examines

Assessing an innovation ecosystem means looking beyond any single organization to the conditions that let innovation flow, and a structured assessment covers several dimensions rather than a single score. Useful dimensions include:

- **Actors** the presence and capability of universities, firms, investors, incubators and intermediaries.
- **Connections** the density and quality of the relationships among them, since isolated strong actors do not make an ecosystem.
- **Resources** access to risk capital, talent, infrastructure and specialist services.
- **Culture and policy** attitudes to entrepreneurship and risk, and the supportiveness of regulation and incentives.
- **Outcomes** the rate of new venture formation, growth and renewal the system actually produces.

Two methods recur in practice. **Network analysis** maps who collaborates with whom and exposes structural weaknesses a hub that is central and well-connected is more resilient than one that is peripheral, regardless of its own output. **Maturity assessment**, introduced through the stage model below, places the ecosystem or hub on a development path and sets stage-appropriate expectations. The two are complementary: maturity says how far along the path a hub is, while network position says how well-embedded it is in the system around it.

The recurring caution is against the **transplant fallacy**: copying the metrics and targets of a famous ecosystem (the Silicon Valley or Cambridge model) into a very different regional context.

An assessment is useful only when it is calibrated to the ecosystem's own stage, assets and constraints, which is the same context-sensitivity that governs responsible benchmarking in the next topic.

Knowledge check 1.8

- Name the four maturity stages and one characteristic of each.
- Why should an emerging hub be assessed mainly on leading indicators and growth?
- Name two ecosystem factors beyond the institution that an assessment should consider.

1.9 Data Collection and Benchmarking Approaches

A metric is only as good as the data behind it, and a benchmark is only as good as the comparability of its definitions. This final topic covers both, turning concepts into trustworthy, comparable numbers.

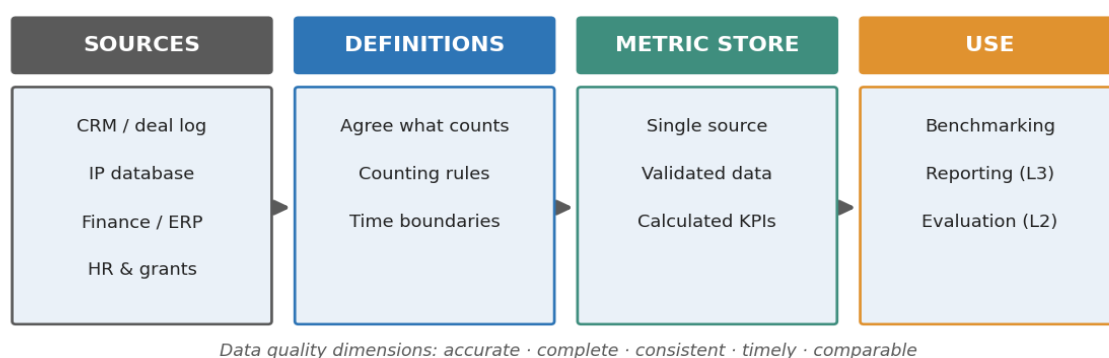


Figure 12. *From sources to use: a simple data architecture for technology transfer metrics. Agreed definitions and a single store are what make numbers consistent and comparable.*

Five data-quality dimensions are worth checking for every indicator: accuracy, completeness, consistency, timeliness and comparability. The single most valuable practical step is to maintain a **data dictionary**, a documented definition, source, owner and counting rule for every KPI. It is the foundation of the 'semantic layer' Lesson 3 relies on, and the cheapest insurance against the most common reporting failure: numbers no one can trust because no one agrees what they mean.

Methods and governance of data collection

Data reaches a metric by one of a few routes, and each has characteristic strengths and biases that the analyst must weigh. **Administrative data** captured in the course of business (the deal log, the IP database, the finance system) is cheap and continuous but only as good as the discipline of those entering it. **Survey data** (the AUTM and ASTP surveys, internal questionnaires) can reach what administrative systems miss, but suffers from non-response and self-report bias the institutions that reply are often the more active ones, which flatters sector averages. **Bibliometric and patent data** from external databases is standardized and comparable but lags reality and captures only the codified, patentable slice of activity. Triangulating across sources is the standard defence against any one source's bias.

Beyond collection sits **data governance**, which is what makes numbers trustworthy over time. Four elements matter: clear *ownership* (a named person accountable for each indicator), *definitions* held in the data dictionary, *validation* routines that catch errors before they reach a report, and attention to *privacy and ethics* commercial data about spin-offs and partners is often

confidential, and aggregate reporting must not expose a single identifiable deal. A measurement system without governance degrades quietly: definitions drift, entry standards slip, and within a few years the trend data becomes uninterpretable because no one can say whether a change is real or an artefact of how the counting changed.

Source	Strength	Characteristic bias
Administrative / internal	Cheap, continuous	Inconsistent entry discipline
Survey	Reaches what admin misses	Non-response and self-report bias
Bibliometric / patent	Standardized, comparable	Lags reality; codified activity only
Qualitative (interviews)	Captures context and quality	Hard to aggregate; subjective

Benchmarking against peers

Two major surveys anchor international comparison: the **AUTM Licensing Activity Survey** in the United States and the **ASTP** annual knowledge-transfer survey in Europe, alongside the European Innovation Scoreboard. Recent AUTM-based data shows the scale of a mature system: U.S. universities executed on the order of **8,800 new licenses and options in FY2021**, around 78% going to start-ups and small firms (up from roughly 69% a decade earlier).³ These are useful context, but benchmarking against them needs care.

The comparability trap: same label, different definition



Always confirm a metric is defined the same way before comparing institutions or countries

Figure 13. *The comparability trap. The same label can hide different definitions across countries, so a metric must be confirmed comparable before institutions are ranked on it.*

Two cautions govern responsible benchmarking. First, **definitions vary**: a spin-off counted at incorporation in one country and at IP-agreement date in another are not the same quantity, which is why European work on harmonizing metrics exists.⁴ Second, **context dominates**: output is highly concentrated, with a few large institutions producing most licenses and income, so comparing a young regional hub to a research giant is meaningless.

³AUTM U.S. Licensing Activity Survey; FY2021 figure (~8,800 new licenses/options; ~78% to start-ups and small firms) via NSF/NCSES Science & Engineering Indicators (INV-13).

⁴ASTP and the JRC report cross-jurisdiction differences in defining and counting spin-offs (incorporation vs IP-agreement date; spin-off vs spin-out vs start-up).

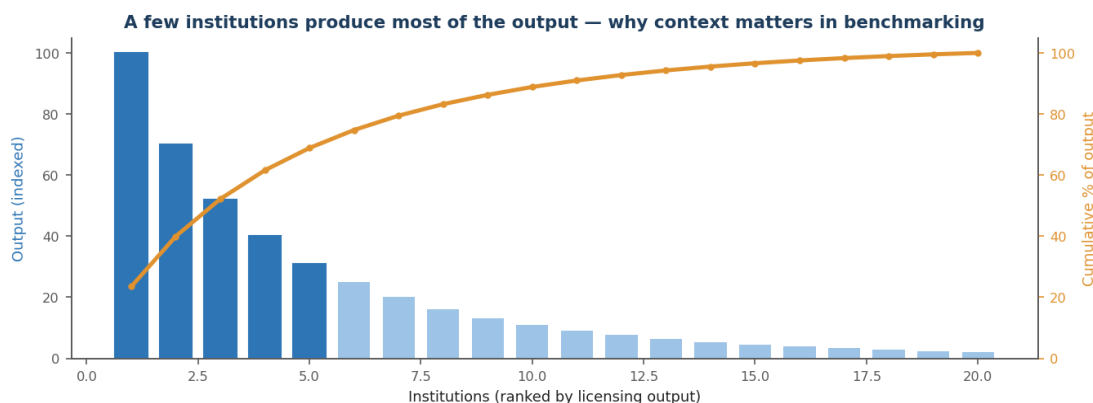


Figure 14. *Output is highly concentrated: a few institutions account for most licensing activity. This skew is why peer-group choice, not raw ranking, makes a benchmark fair.*

The practical rule follows directly: benchmark against institutions of similar mission, size and research intensity, and always confirm a metric is defined the same way before comparing it.

Knowledge check 1.9

- Name the five data-quality dimensions and what a data dictionary contains.
- Name the main US and European benchmarking surveys for technology transfer.
- Give two reasons cross-country benchmarking can mislead, and the rule for choosing a peer group.

Summary and Key Takeaways

Lesson 1 has built the conceptual foundation for measuring technology transfer. The recurring theme is that **metrics are design choices**: each embeds a definition, a boundary and an assumption about success, and choosing them well separates measurement that guides an institution from measurement that merely decorates it.

The essential points to carry into Lessons 2 and 3:

- **Measure all channels.** Licensing is one route among many; capture collaboration, spin-offs, mobility and public-good transfer too.
- **Use the full set of performance indicators.** Inputs through impact, leading and lagging, quantitative and qualitative.
- **Define every KPI once.** A documented data dictionary is the foundation of trustworthy, comparable numbers.
- **Measure interactions, not just actors.** The Triple Helix locates value in university–industry–government overlap.
- **Track the commercialization funnel.** Conversion and skew matter as much as totals.
- **Value social returns.** SROI captures public-mission value, with transparent assumptions.
- **Evaluate the TTO fairly.** Efficiency, effectiveness and metric quality; beware Goodhart’s law.
- **Fit assessment to maturity and peer group.** Judge an emerging hub on growth; benchmark only against comparable institutions.

Common conceptualization pitfalls and their fixes

Pitfall	Why it fails	Fix
Single-channel measurement	Ignores collaboration, training, public-good transfer	Measure all channels (1.1)
Output obsession	Easy counts crowd out hard-to-attribute impact	Use the full taxonomy (1.2)
Undefined KPIs	Same label, different numbers; not comparable	Maintain a data dictionary (1.9)
Target fixation	Invites gaming (Goodhart's law)	Balanced set; pair quantity with quality (1.7)
Naive benchmarking	Compares unlike institutions or definitions	Match peer group; confirm definitions (1.9)
Stage-blind targets	Holds an emerging hub to a mature hub's metrics	Fit metrics to maturity (1.8)

Looking ahead

Lesson 2 takes the economic outcomes defined here license income, spin-offs, jobs, products, and asks what they are worth, through ROI, IRR, cost-benefit analysis and economic-impact modeling. Lesson 3 turns the whole indicator set, including SROI, into dashboards, briefs and impact narratives. The integrated practical assignment runs the full chain on a single technology transfer hub.

Metric Design Toolkit

The templates below operationalize the lesson. They are written to be copied straight into a hub's practice or a Moodle resource.

Template 1 KPI definition sheet

Complete one sheet for every KPI before it is reported. This is the unit of the data dictionary that underpins trustworthy, comparable metrics.

Field	Guidance / worked example
KPI name	Invention disclosures per 100 academic staff
Definition & formula	Disclosures received in the year ÷ (academic FTE / 100)
Taxonomy category	Output (leading)
Source system	Disclosure log / CRM; HR for staff FTE
Counting rule	Count at date received; exclude resubmissions
Data owner	TTO operations manager
Quality checks	Validity (captures activity, not paperwork); reliability (same rule across faculties)
Gaming risk & guard	Trivial disclosures → pair with conversion rate

Template 2 ‘Good metric’ checklist

1. Does it measure what we intend (validity)?
2. Will two people measure it the same way (reliability)?
3. Is it SMART specific, measurable, achievable, relevant, time-bound?
4. Which taxonomy category is it (inputs → impact)?
5. Is it leading or lagging; quantitative or qualitative?
6. Is it defined in the data dictionary with an owner and source?
7. How could it be gamed, and what balancing metric guards against it?
8. Is it comparable to the benchmark it will be set against?
9. Does it fit the hub’s maturity stage?

Glossary of Key Terms

Term	Definition
Attribution gradient	The tendency for impact to matter more but be harder to attribute to the TTO than outputs.
Benchmarking	Comparing an institution’s indicators against peers; valid only when definitions match.
Data dictionary	A documented definition, source, owner and counting rule for each KPI.
Deadweight	In SROI, the share of an outcome that would have happened anyway, excluded from the value.
Goodhart’s law	When a measure becomes a target, it ceases to be a good measure.
Impact	Long-term value created (economic, social, environmental); the end of the taxonomy.
Innovation ecosystem	The full system of actors universities, firms, government, investors, intermediaries, society.
Invention disclosure	A formal report by a researcher of a potentially commercializable invention.
Leading / lagging indicator	An early predictive signal vs a measure that confirms results after the fact.
Pipeline conversion	Share of disclosures progressing to a later stage such as a license.
Reliability	Whether an indicator measures consistently across people and time.
SROI	Social Return on Investment monetized social value expressed as a ratio to investment.
TTO	Technology Transfer Office, the unit managing commercialization for an institution.
Technology Level (TRL)	Readiness A 1–9 scale of a technology’s maturity, from basic research (1–3) to operational deployment (8–9).
Triple Helix	Model holding that innovation arises from university–industry–government interaction.
Validity	Whether an indicator measures what it is intended to measure.

Lesson 2: Economic Impact and Return on Investment (ROI)

Lesson overview. This lesson focuses on the value created by technology transfer and the financial and economic methods used to evaluate it. It addresses direct, indirect and induced impact, commercialization revenue, cost-benefit analysis, ROI, NPV, IRR, jobs, licensing, spin-offs and sustainability.

Learning outcomes

- Explain direct, indirect and induced economic impact.
- Identify commercialization revenue mechanisms and their risk profiles.
- Apply ROI, NPV, IRR, payback and cost-benefit analysis.
- Assess job creation and multiplier effects responsibly.
- Analyze startup/spin-off and licensing performance.
- Evaluate long-term financial sustainability.

Core topics

- Economic impact of technology transfer
- Commercialization and revenue generation
- Cost-benefit analysis
- ROI, NPV, IRR and payback
- Job creation and economic multipliers
- Startup and spin-off cohort analysis
- Licensing revenue and patent portfolio analysis
- Institutional prestige and brand value
- Financial sustainability of innovation hubs

Learning activity / reflection

For a proposed commercialization project, calculate a simple ROI and explain why NPV or IRR may be preferable for a multi-year investment decision.

Lesson summary

Economic evaluation should match the method to the question. Analysts should state assumptions, respect the time value of money, use locally relevant multipliers and avoid misleading averages.

Lesson 2 at a Glance

Lesson 1 defined what to measure; this lesson asks the harder question: **what is it worth?** Economic evaluation is where technology transfer earns or loses its case for investment, where disclosures, licenses and spin-offs are translated into returns, jobs, regional growth and financial sustainability. The methods here are standard tools of finance and economics, applied to the particular conditions of research commercialization: long time lags, deep uncertainty, and returns that are extraordinarily skewed.

The central message is that **value in technology transfer is real but unevenly distributed and easily mis-stated.** A single blockbuster license can dwarf a decade of other deals; a spin-off's jobs ripple through a regional economy; and the same project can show a poor financial ROI yet a strong economic and social return. Measuring economic impact well means using the right tool for

the right question, stating assumptions honestly, and never letting an average hide the distribution beneath it.

Learning outcomes

By the end of Lesson 2, participants will be able to:

1. Explain how technology transfer creates direct, indirect and induced economic impact.
2. Identify the main revenue mechanisms of commercialization and their risk and timing profiles.
3. Apply cost–benefit analysis, ROI, NPV, IRR and payback, and choose the right measure for the question.
4. Quantify job creation and apply economic multipliers responsibly.
5. Analyze startup and spin-off performance using cohort methods.
6. Analyze licensing revenue and manage a patent portfolio given the skew of returns.
7. Assess institutional prestige and brand value using credible proxies.
8. Evaluate the financial sustainability of an innovation hub.

How this lesson connects to the others

Lesson 1 defined and collected the indicators (and introduced SROI). **This lesson** values the economic outcomes. **Lesson 3** reports the whole picture through dashboards, briefs and impact narratives. Financial figures in this lesson are illustrative unless attributed to a named source.

2.1 Economic Impact of Technology Transfer

Economic impact is the total effect of technology transfer activity on output, income and employment in an economy. It is wider than the revenue a TTO collects: a spin-off does not only earn the university royalties, it employs people, buys from suppliers, and pays taxes, and those effects ripple outward. Economists decompose the total into three layers.

How technology transfer creates economic impact



Total impact = Direct + Indirect + Induced

The ratio of total to direct impact is the economic multiplier

Figure 1. Economic impact has three layers direct, indirect and induced. The ratio of total to direct impact is the economic multiplier (Topic 2.5).

- **Direct impact** the jobs, sales and taxes of the spin-offs and licensees themselves.
- **Indirect impact** activity generated up the supply chain as those firms buy goods and services.
- **Induced impact** activity created when employees spend their wages in the wider economy.

This distinction matters: reporting only direct impact understates the contribution, while claiming the full multiplied figure without method or source overstates it. Credible economic-impact measurement names its boundary (which firms, which region, which years), uses recognized methods, and separates what is *attributable* to the technology transfer from what would have happened anyway. The methods of valuing these effects cost–benefit analysis, ROI, IRR and multipliers occupy the rest of this lesson.

How economic impact is actually estimated

Turning the three layers into a credible number requires a method, and the standard one is **input–output (I–O) analysis**, which uses a matrix of how each sector buys from every other to trace how an initial change ripples through an economy. From the I–O table economists derive the multipliers used in Topic 2.5. A related and increasingly common approach is *economic contribution analysis*, which estimates the total activity associated with a set of firms (the approach behind the well-known national studies of university licensing). The essential discipline in either method is to be explicit about the *boundary* which firms, which geography, which time period because a wider boundary always produces a larger and less defensible number.

Three adjustments separate an honest impact estimate from an inflated one, and they mirror the logic of SROI in Lesson 1. **Additionality** asks how much of the activity would have occurred without the technology transfer only the additional part counts. **Displacement** asks whether the new activity simply pushed out existing activity elsewhere (a new firm capturing a rival’s customers is not all net gain). **Attribution** recognizes that a spin-off’s success depends on investors, managers and markets as well as the original research, so the institution can claim only a share. An estimate that ignores these three will overstate impact, sometimes by a wide margin, and a reader’s first question of any large impact figure should be how they were handled.

Finally, impact is *gross or net*, and the two are often confused in advocacy. Gross impact counts all associated activity; net impact subtracts deadweight and displacement. Net impact is the honest figure for evaluation, even though gross impact makes the better headline a tension that returns in Lesson 3’s discussion of honest reporting.

Knowledge check 2.1

- Define economic impact and distinguish direct, indirect and induced effects.
- Why does reporting only direct impact understate a hub’s contribution?
- Name two things a credible economic-impact estimate must specify.

2.2 Commercialization and Revenue Generation

Before value can be measured it must be generated. Commercialization produces revenue through several distinct mechanisms, and a healthy hub usually combines them rather than relying on one. Understanding the mix is essential because the mechanisms differ sharply in timing, risk and size.



Figure 2. *The main routes to revenue from commercialization. Most license deals blend several; equity is the highest-risk and most skewed.*

Three features distinguish these revenue streams. **Timing:** upfront fees arrive immediately, royalties accrue over years, equity pays only at an exit that may never come. **Risk:** minimum annual payments are near-certain, royalties depend on a product selling, equity is binary. **Size:** equity in a successful spin-off can dwarf all other income combined, but most equity stakes return little. A sound revenue strategy therefore balances predictable income (fees, minimums, service income) against high-skew upside (royalties on a hit product, equity in a breakout venture).

Worked example: structuring a license deal

A university licenses a diagnostic to a medtech firm. Rather than a single payment, the deal blends:

- **€25k upfront** on signature (covers patent costs, signals commitment);
- **€10k minimum annual payment** (income floor regardless of sales);
- **4% running royalty** on net sales (shares the upside);
- **milestone payments** at regulatory approval and first sale (rewards progress).

The blend protects the university if the product is slow, while preserving large upside if it succeeds.

Valuing and structuring a deal

Behind every revenue stream lies a harder question: what is the technology worth, and how should payment be structured to reflect that? Three valuation approaches are standard, and each suits different circumstances. The **cost approach** values the technology at what it cost (or would cost) to develop simple, but a poor guide to market value. The **market approach** infers value from comparable deals sound where comparables exist, which for novel research they often do not. The **income approach** projects the future cash flows the technology will generate and discounts them to present value, which is the most defensible method but depends heavily on uncertain forecasts. In practice a negotiator triangulates across all three.

Deal structure then allocates **risk** between the parties, and reading a structure is largely about seeing who bears which risk. A high upfront fee shifts risk to the licensee (they pay before knowing the product succeeds); a pure running royalty shifts risk to the licensor (they earn only if it sells). The instruments in the figure above are the levers: milestones release value as technical risk falls, minimum annual payments protect the licensor against a licensee who sits on the technology, and equity converts the licensor into a co-owner of the upside and the downside alike. The art is to match the structure to the uncertainty the deeper the uncertainty about whether a product will reach market, the more value should be deferred to milestones and royalties rather than taken upfront.

Valuation approach	Basis	Best when...
Cost	What development cost	Early stage; no market signal yet
Market	Comparable deals	Active market with comparables exists
Income	Discounted future cash flows	Cash flows can be reasonably forecast

Knowledge check 2.2

- Name four mechanisms by which commercialization generates revenue.
- How do upfront fees, royalties and equity differ in timing and risk?
- Why does a hub blend predictable income with high-skew upside?

2.3 Cost-Benefit Analysis in Innovation Projects

Cost–benefit analysis (CBA) asks the most basic evaluation question: do the benefits of an activity exceed its costs, once both are placed on a comparable footing? For innovation projects the challenge is that costs come early and with certainty, while benefits come late and uncertain, so the two cannot simply be added up without accounting for *time*.

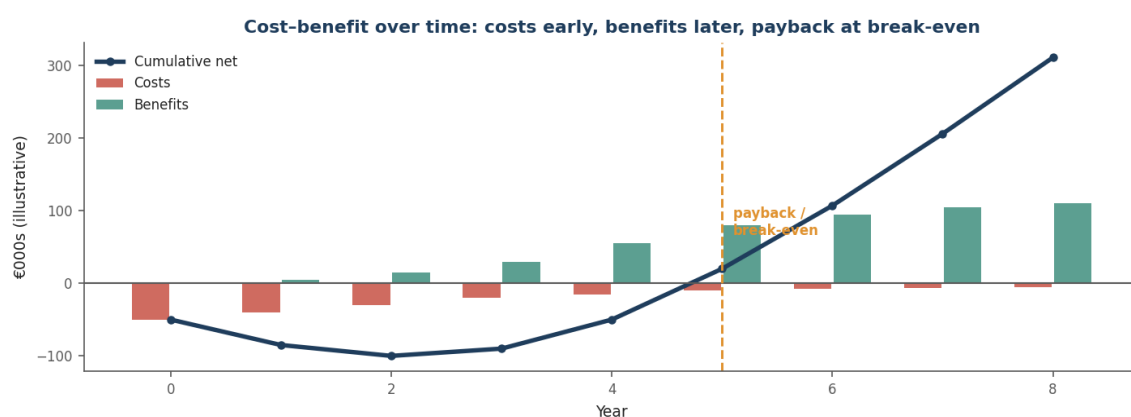


Figure 3. A cost–benefit profile typical of innovation: costs concentrated early, benefits accruing later, with payback at the break-even point where cumulative net turns positive.

Two adjustments make costs and benefits comparable. **Discounting** recognizes that a euro today is worth more than a euro in ten years, by converting future cash flows to their present value using a discount rate. **Counterfactual adjustment** subtracts what would have happened without the project, only the additional benefit counts. A disciplined CBA also tests how sensitive its conclusion is to key assumptions (the discount rate, the size and timing of benefits), because innovation benefits are genuinely uncertain.

CBA underpins the specific return measures that follow: net present value, ROI and IRR are all ways of summarizing a cost–benefit profile in a single comparable number.

Discounting, sensitivity and decisions under uncertainty

The mechanics of discounting reward a moment’s attention because the **discount rate** silently drives the conclusion. A future amount is converted to present value by dividing by $(1 + r)$ raised to the number of years away, so a higher rate penalizes distant benefits more heavily. Since

technology transfer benefits arrive late, the choice of rate can move a project from clearly worthwhile to clearly not which is why the rate should be stated, justified (typically the organization's cost of capital or a government-set social discount rate), and tested rather than buried.

Because the inputs are uncertain, a single point estimate is rarely honest, and three techniques manage that uncertainty. **Sensitivity analysis** re-runs the calculation while varying one assumption at a time to see which assumptions actually matter. **Scenario analysis** builds coherent best, base and worst cases rather than varying inputs in isolation. **Expected-value** thinking weights each outcome by its probability, which is especially apt for technology transfer because the payoff distribution is so skewed a small chance of a very large success.

That skew points to a deeper idea: the **real-options** view of innovation investment. A conventional cost–benefit calculation can reject an early-stage project because its expected NPV is negative, yet the project may still be worth funding because it buys the *option* to continue if early results are good and to stop cheaply if they are not. Staged investment fund a little, learn, then decide has value that a single-shot NPV misses. This is why a portfolio of small, staged bets often beats one large committed project, and why an emerging hub's many small experiments should not be judged as if each were a final commitment.

NPV (€000s) at...	Benefits –20%	Base benefits	Benefits +20%
Discount rate 6%	+18	+96	+174
Discount rate 8%	–12	+60	+132
Discount rate 10%	–38	+28	+94

A sensitivity table like this one is the honest way to present an uncertain appraisal. It shows at a glance that the project is robust to benefit shortfalls at a low discount rate but turns negative under the combination of a high rate and disappointing benefits information a single 'NPV = +€60k' would have hidden. Reporting the table rather than the point estimate lets a decision-maker see the risk, not just the expected value.

Knowledge check 2.3

- What basic question does cost–benefit analysis answer?
- Why must future benefits be discounted, and what is the counterfactual adjustment?
- Why is sensitivity analysis especially important for innovation projects?

2.4 Return on Investment (ROI) and Internal Rate of Return (IRR)

Four related measures summarize whether an investment pays off. Each answers a slightly different question, and using the wrong one is a common source of misleading conclusions.

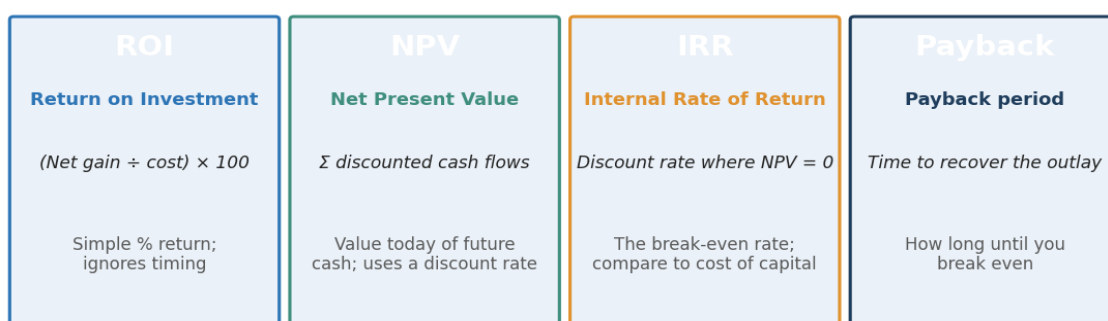


Figure 4. Four core return measures. ROI is simple but ignores timing; NPV and IRR account for the time value of money; payback measures speed of recovery.

- **ROI** = net gain ÷ cost, as a percentage. Simple and intuitive, but it ignores when the cash flows occur, a 50% return over one year and over ten years look identical.
- **NPV** (net present value) sums all cash flows discounted to today. A positive NPV means the project creates value at the chosen discount rate.
- **IRR** (internal rate of return) is the discount rate at which NPV equals zero, the project's break-even rate of return, compared against the cost of capital.
- **Payback period** is the time taken to recover the initial outlay, a measure of speed and risk, not of total value.

Worked example: ROI vs NPV

A TTO invests €200k in a patent and incubation program. Over five years it returns €320k in total income.

Simple ROI = $(320 - 200) \div 200 = 60\%$ looks strong.

But most income arrives in years 4–5. Discounting at 8%, the present value of the returns is about €245k, so **NPV** ≈ **+€45k** still positive, but far less impressive than '60%' suggested. The timing matters.

For technology transfer, ROI is best used for quick communication, while NPV and IRR are used for decisions, because the long lags between investment and return make timing decisive.

Choosing and combining the measures

Each measure can mislead if used alone, and a competent analyst knows the failure modes. **IRR** is intuitive but treacherous: a project whose cash flows change sign more than once can have several mathematically valid IRRs, and IRR implicitly assumes interim cash is reinvested at the IRR itself, which flatters high-return projects. It also cannot, by itself, compare projects of different size a 60% return on €10k is worth less in absolute terms than a 20% return on €1m. **NPV** avoids these traps and is the measure to trust when two measures disagree, but it gives an absolute figure that is hard to compare across projects of different scale. **Payback** is simple and speaks to risk and liquidity, but ignores everything that happens after the outlay is recovered, including the large late benefits typical of technology transfer.

Measure	Key weakness	Use it for...
ROI	Ignores timing of cash flows	Quick communication

NPV	Absolute figure; scale-dependent	The decision when measures conflict
IRR	Multiple roots; reinvestment assumption	A comparable rate, read with NPV
Payback	Ignores post-payback value	A read on risk and liquidity
Profitability index	Less familiar to non-specialists	Ranking projects under a budget cap

The practical rule is to report a small panel rather than a single figure: NPV for the decision, IRR for comparability, and payback for risk, with ROI reserved for the headline. When they conflict, NPV governs. And every one of them inherits its credibility from the cash-flow forecast beneath it a precise IRR computed from a fanciful revenue projection is precisely wrong, which is why the sensitivity discipline of Topic 2.3 matters more than the choice among these measures.

Knowledge check 2.4

- Define ROI, NPV, IRR and payback period in one line each.
- Why can ROI mislead when cash flows are spread over many years?
- What does it mean for a project to have a positive NPV at an 8% discount rate?

2.5 Job Creation and Economic Multiplier Effects

Among the most valued outcomes of technology transfer are the jobs it creates in spin-offs, in licensee firms, and through the supply chains and spending those generate. Job creation is also where the **multiplier effect** introduced in Topic 2.1 is quantified.

The economic multiplier effect



Multipliers vary by sector and region; use published, locally-relevant values, not guesses

Figure 5. *The economic multiplier: total impact expressed as a multiple of the direct effect. A multiplier of about 2.0 means each direct job or euro supports roughly one more indirectly.*

An **economic multiplier** expresses total impact as a multiple of the direct effect. If 100 direct jobs in spin-offs support a further 100 jobs through supply chains and induced spending, the employment multiplier is about 2.0. Multipliers are powerful in advocacy but easily abused: they vary substantially by sector and region, and applying a high multiplier from one context to another inflates the figure. The discipline is to use **published, locally relevant multipliers** (for example from national statistics offices or input–output models) and to state the source never to pick a flattering number.

Job-quality matters as much as job-count: research-based ventures typically create skilled, higher-wage employment, which is part of why governments value technology transfer beyond its direct revenue.

Where multipliers come from, and how they mislead

A multiplier is not a universal constant but a number derived from a specific economy's structure, and understanding its origin is the best defence against misuse. Type I multipliers capture direct plus indirect (supply-chain) effects; **Type II** multipliers add the induced effect of re-spent wages and are therefore larger. Quoting a Type II figure where a Type I is appropriate is a common way to inflate impact. Multipliers also vary by *sector* (manufacturing typically higher than services, because of longer domestic supply chains) and by *region* (a small open regional economy 'leaks' spending to outside suppliers, lowering its local multiplier). The single most common error in practice is to borrow a national manufacturing multiplier and apply it to a regional service-sector spin-off.

Job-quality measurement deserves equal care, because a headcount conceals as much as it reveals. Useful refinements include **full-time-equivalent** conversion (so part-time and temporary roles are not over-counted), *wage level* (research-based jobs are typically higher-paid, which is part of their value), and *durability* (a job that lasts a decade is worth more than one that lasts a year). A hub reporting 'jobs created' should ideally state FTEs, an indication of wage level, and the period over which the jobs persisted, rather than a bare cumulative count that mixes a durable engineering post with a three-month internship.

Multiplier element	Captures	Note
Direct	Jobs/output in the firms themselves	The starting point
Indirect (Type I)	Supply-chain activity	Higher for long domestic chains
Induced (Type II)	Re-spent wages	Larger; easy to over-claim
Regional leakage	Spending lost outside the region	Lowers the local multiplier

Knowledge check 2.5

- **Define the economic multiplier and interpret a value of 2.0.**
- **Why must multipliers be drawn from locally relevant, published sources?**
- **Why is job quality, not just job count, relevant to the economic case?**

2.6 Startup and Spin-Off Performance Indicators

Spin-offs are among the highest-impact outcomes of technology transfer, but also the hardest to measure well, because their value emerges over many years and most of it concentrates in a few successes. Performance indicators must therefore track ventures *over time*, not as a one-off count.

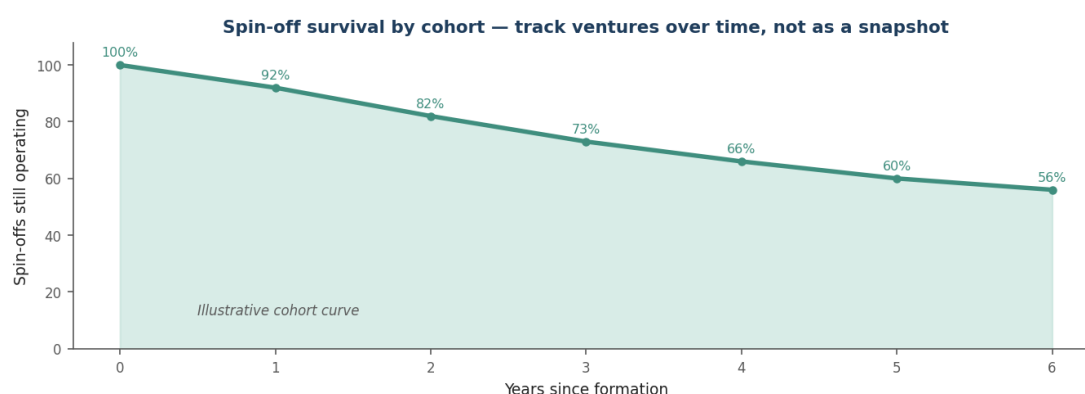


Figure 6. A spin-off survival curve by cohort. Tracking each year's ventures over time is more honest than a single snapshot that blends young and mature companies.

Useful spin-off and start-up indicators include:

- **Survival rate** the share of a cohort still operating after three, five or seven years.
- **Employment** jobs created and their growth over time.
- **Follow-on investment** external capital raised, a strong market signal of value.
- **Revenue and growth** turnover and its trajectory.
- **Exits** acquisitions or public offerings, where equity value is realized.

The key methodological point is **cohort (vintage) analysis**: grouping ventures by the year they were founded and following each group forward. A blended average that mixes a three-year-old venture with a fifteen-year-old one tells you little; cohort curves reveal whether the hub's spin-offs actually survive and grow. As with licenses, spin-off value is heavily skewed, a single successful exit can outweigh dozens of modest ventures.

Measuring ventures rigorously

Tracking ventures well borrows directly from the discipline of **survival analysis**. The central subtlety is *censoring*: at any reporting date some ventures are simply too young to have reached a milestone, and counting them as failures (or ignoring them) distorts the picture. The honest approach reports survival by cohort age the three-year survival of the ventures old enough to have a three-year mark rather than blending all ages together. A related trap is *survivorship bias*: measuring only the ventures that still exist flatters the average and hides the ones that quietly closed.

Venture value is also **staged**, and the right indicator depends on the stage. Early on, *input and milestone* indicators matter (capital raised, key hires, first customers); later, *performance* indicators dominate (revenue, growth, employment); and only at an *exit* (acquisition or public offering) is equity value finally realized. **Follow-on investment** deserves emphasis as a leading indicator because it is an external market judgement sophisticated investors risking their own capital is a stronger signal of promise than any internal metric, which is why venture and innovation analysts watch it closely.

Venture stage	What to measure	Why
Formation	Capital raised, key hires	Inputs predict early viability
Early growth	First customers, follow-on funding	External validation of promise
Scale-up	Revenue, employment, growth rate	Performance becomes measurable
Exit	Acquisition / IPO value	Equity value is finally realized

Knowledge check 2.6

- Name four indicators of spin-off performance beyond simple count.
- What is cohort analysis and why is it more honest than a blended average?
- Why does follow-on investment serve as a useful market signal of value?

2.7 Licensing Revenue and Patent Portfolio Analysis

Licensing is the most direct financial return from research, and the patent portfolio is the asset base that generates it. Both must be analyzed with a clear understanding of one dominant fact: returns are **extremely skewed**.

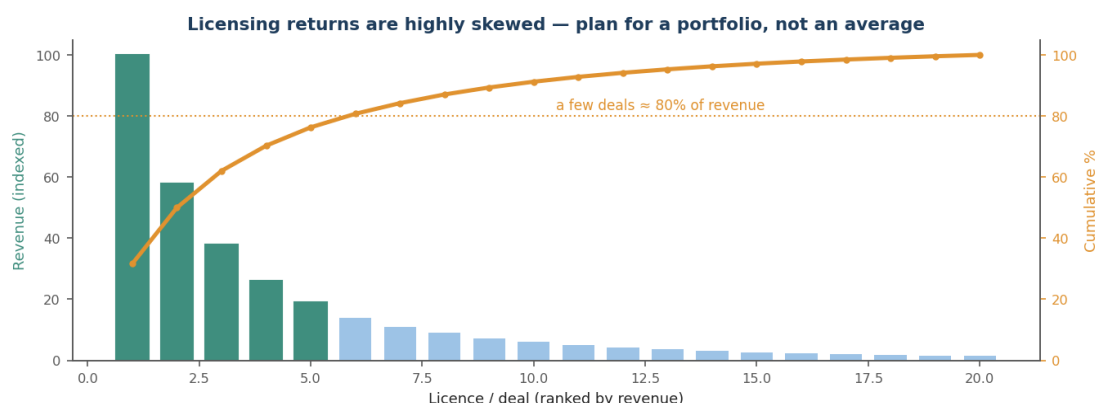


Figure 7. *Licensing returns follow a power law: a few ‘home-run’ deals generate the large majority of revenue, so the average deal is a poor guide and the distribution must be reported.*

The classic illustration is Stanford’s Cohen–Boyer recombinant-DNA patents, licensed non-exclusively to several hundred companies and earning roughly \$255 million over the life of the patents, yet about four-fifths of that revenue came from a small number of products.⁵ The practical consequences for measurement are direct: report the *distribution* of license income, not just the total or mean; set realistic expectations (most licenses earn little); and treat the rare blockbuster as the exception it is, not the planning assumption.

The statistics of skew, and what they demand

The skew of licensing returns is not a quirk to note in passing; it has a definite statistical shape with real consequences for measurement. Returns approximately follow a **power law** (a ‘heavy-tailed’ distribution) rather than the bell-shaped normal distribution that most intuitions assume. In a heavy-tailed distribution the *mean is dominated by the largest observation* and is therefore unstable and misleading add or remove one blockbuster and the average lurches. The honest summary statistics for such data are the **median** (the typical deal, far below the mean), the full **distribution or percentiles**, and the *concentration* (what share of revenue comes from the top few deals).

This shape has three direct consequences. First, for *planning*: a hub cannot budget on the expectation of a blockbuster, because in any given year almost no deals are one. Second, for *evaluation*: judging an office by mean income per deal punishes the many sound, modest deals that are the realistic backbone of the work. Third, for *strategy*: because a few large successes drive the total, the rational posture is a portfolio of many shots rather than a few heavily-backed bets the same logic that governs venture capital and the real-options thinking of Topic 2.3.

Managing the patent portfolio

Patents are not free to hold filing and maintenance cost money across many jurisdictions for up to twenty years. A portfolio should therefore be managed as an **investment portfolio**, not a trophy cabinet: most value sits in a few assets, and holding low-potential patents drains budget that could support the promising ones.

⁵Feldman, Colaianni & Liu (2007) on the Stanford Cohen–Boyer program: non-exclusive licenses to several hundred companies; total revenue of roughly \$255 million over the life of the patents, with about 80% of revenue from a small number of products.

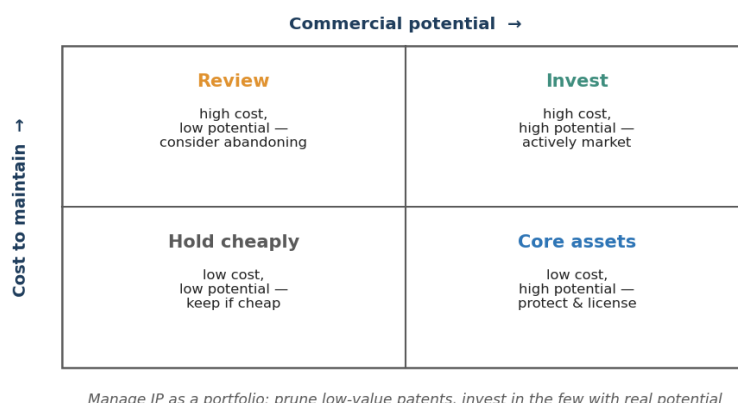


Figure 8. A patent portfolio matrix. Patents are assessed on commercial potential against maintenance cost; the discipline is to prune low-value assets and invest in the few with real potential.

Setting a royalty rate

One question dominates day-to-day licensing practice: what royalty rate is fair? Three reference methods are used, and a negotiator typically checks a proposed rate against all three. **Comparable-deal** benchmarking looks at published rates for similar technologies in the same industry pharmaceutical rates differ markedly from software or materials rates. The **25% rule** of thumb suggests the licensor receive roughly a quarter of the licensee's expected operating profit from the product, as a starting anchor rather than a precise entitlement. The *income approach* projects the product's cash flows and asks what royalty leaves the licensee an adequate return while fairly rewarding the invention. None gives a single 'right' number; they bound a negotiation range, and the final rate reflects relative bargaining power, the stage of development, and how much risk and cost each side carries forward.

Measurement connects to this in two ways. First, the realized *effective royalty rate* (income received divided by licensee sales) is itself a KPI worth tracking, since it reveals whether the office is capturing fair value over time. Second, because rates and outcomes vary so widely, a portfolio of licenses should be reported by distribution, not by a single average rate the same heavy-tail discipline that governs license income as a whole.

Knowledge check 2.7

- Why does the skew of licensing returns mean the average deal is a poor guide?
- State two reporting consequences of the licensing power law.
- Why should a patent portfolio be managed like an investment portfolio?

2.8 Institutional Prestige and Brand Value through Innovation

Not all returns from technology transfer are financial. A strong record of commercialization builds **intangible value** reputation, prestige and brand that benefits the whole institution in ways that rarely appear on a balance sheet but are real nonetheless.

These intangible returns operate through several channels:

- **Talent attraction** a reputation for impact draws strong researchers, students and industry partners.

- **Funding leverage** demonstrated commercialization strengthens grant and investment applications.
- **Partnership pull** firms prefer to collaborate with institutions known for translating research.
- **Regional standing** a visible innovation record raises an institution's political and civic weight.

Measuring intangible value is genuinely hard, and over claiming is a real risk. Honest approaches use *proxy indicators* media mentions of spin-offs, rankings that weight innovation, partner and applicant survey responses, the prestige of partners attracted always presented as indicative rather than precise. The most credible treatment pairs a few such proxies with concrete narrative examples, and avoids converting reputation into a spurious monetary figure. Brand value is best reported as supporting evidence alongside the financial and economic returns, not as a headline number in its own right.

Approaches to measuring the intangible

Although brand and reputation resist precise measurement, the discipline offers recognized approaches, and naming them keeps the analysis honest rather than hand-waving. Broadly there are three. **Proxy indicators** track observable signals that correlate with reputation media mentions, ranking positions that weight innovation, the caliber of partners attracted, application and acceptance rates. **Revealed-preference** methods infer value from behavior: if firms pay a premium to partner with an institution, or students forgo cheaper options to attend it, that willingness reveals a value the institution's reputation commands. **Survey-based** methods ask stakeholders directly, accepting the limits of self-report.

The recurring temptation is to convert these into a single monetary 'brand value', and it should be resisted in this context. Commercial brand-valuation techniques exist, but they rest on assumptions (a royalty rate the institution could charge for its name, or a premium attributable purely to brand) that are speculative for a public research institution and invite exactly the over claiming the course warns against. The defensible posture is to present a small set of proxies, alongside concrete narrative evidence, as **supporting** rather than headline metrics reputation corroborates the financial and economic case rather than standing in for it. This restraint is itself a mark of credibility: a report that puts a confident euro figure on prestige usually reveals more about its author's incentives than about the institution's worth.

Approach	Example signal	Caution
Proxy indicators	Media mentions; innovation rankings	Correlation, not proof of value
Revealed preference	Premium paid by partners	Hard to isolate from other factors
Survey	Stakeholder perception scores	Self-report bias

Knowledge check 2.8

- Name three channels through which innovation builds institutional brand value.
- Why is intangible value difficult to measure, and what is the main risk?
- What is the most credible way to report brand value?

2.9 Financial Sustainability of Innovation Hubs

A final economic question is whether the technology transfer operation can sustain itself. Very few TTOs fully cover their costs from earned income, and expecting them to misunderstands their purpose, but the **trajectory toward sustainability** is a meaningful measure of a hub's development.

Every innovation has **two lives**: a *project life* funded by a grant, and a *commercial life* that must be sustained after the grant ends. Few institutions manage the second, yet that is where impact is realized, and innovation failure is rarely technological; far more often it occurs when an institution simply stops managing a technology once the funding stops. Financial-sustainability metrics measure whether that second life is viable.

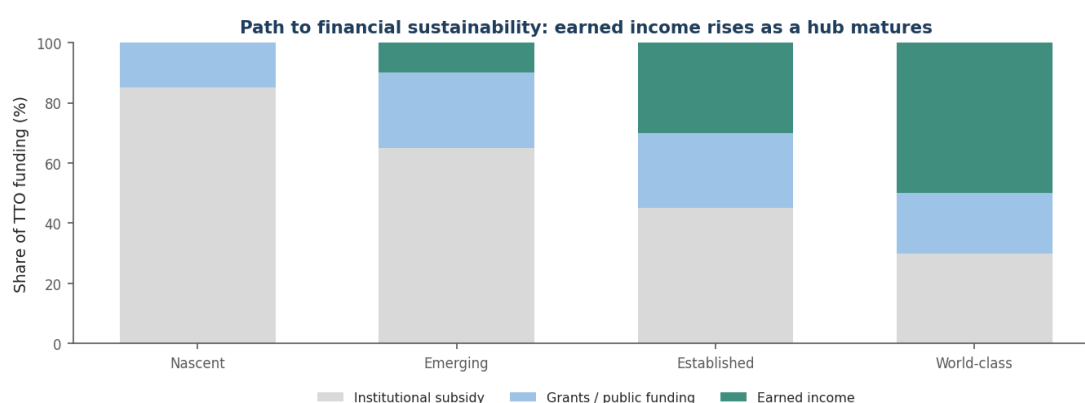


Figure 9. *The funding mix typically shifts with maturity: institutional subsidy and grants dominate early, while earned income grows as a hub matures. Full self-funding is rare and not the only definition of success.*

Several measures track financial health: the **cost-recovery ratio** (earned income as a share of operating cost), the **diversity of revenue** (dependence on a single deal is fragile), and the size of any **reserves** that buffer the inherent lumpiness of licensing income. Because returns are so skewed and slow, a hub can do excellent work for years before a major success, so financial sustainability must be judged over a long horizon and against the hub's maturity stage, an emerging hub that recovers 10% of its costs may be on a healthier trajectory than a mature one stuck at 30%.

Worked example: reading a hub's annual return

A hub spends €300k a year. It earns €180k in license income, realizes €260k from a spin-off equity sale, and bills €140k in contract research.

Net return for the year is +€280k, but the €260k equity sale is a one-off. Stripping it out, recurring income (€320k) still exceeds cost, a genuinely healthy sign; relying on the equity windfall to declare success would be misleading.

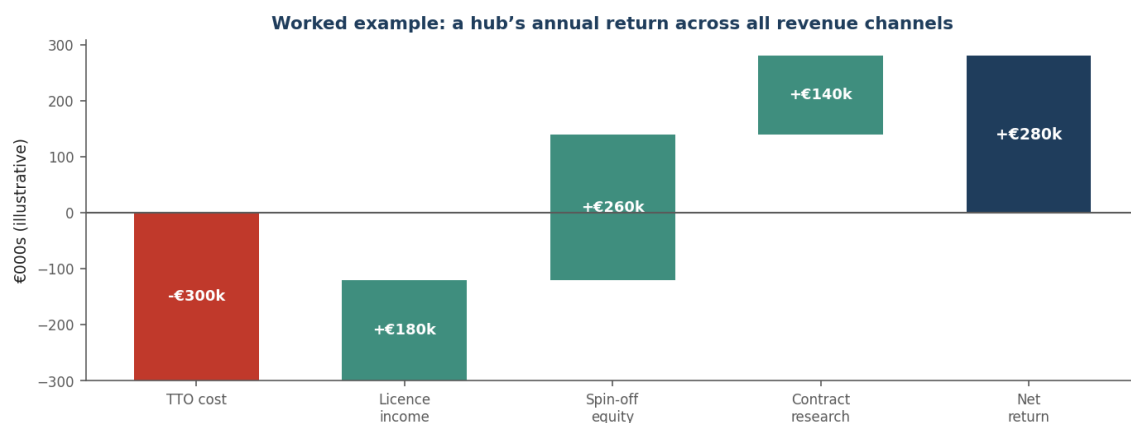


Figure 10. *Worked example: a hub's annual return across all channels. Separating one-off windfalls (equity) from recurring income is essential to judging sustainability honestly.*

Funding models and the path to viability

Sustainability is shaped by the **funding model** a hub operates under, and these sit on a spectrum. At one end is the fully *subsidized* office funded as research infrastructure, judged on mission rather than self-funding. At the other is the *self-financing* or even profit-distributing office that returns a surplus to the institution. Most sit between, mixing institutional subsidy, public grants and a growing share of earned income, and the realistic ambition for a developing hub is to move along this spectrum rather than to leap to self-funding, which very few research-driven offices ever reach.

Two analytical tools make sustainability concrete. A **break-even analysis** asks what volume of activity how many deals at the median value, given the skew of Topic 2.7 would be needed to cover operating cost, which is sobering and useful: it usually shows that recurring deal income alone cannot cover costs for years, and that contract and service income carry the office in the meantime. A *contribution analysis* separates the income streams by how reliably they cover cost: predictable service and contract income forms a base, while licensing and equity provide volatile upside. A hub whose fixed costs are covered by its stable base is far more resilient than one of equal total income that depends on a windfall, even though a single year's accounts may make them look alike which is why sustainability must be read across several years and by composition, not by a single year's bottom line.

Knowledge check 2.9

- Why is full cost recovery a misleading target for most public TTOs?
- Name three measures of a hub's financial health.
- Why must one-off windfalls be separated from recurring income when judging sustainability?

Summary and Key Takeaways

Lesson 2 has shown how to value what technology transfer produces. The recurring theme is that **value is real, skewed and easily mis-stated**: the right method depends on the question, the time value of money is decisive, and averages routinely hide the distribution that actually drives results.

The essential points to carry into Lesson 3:

- **Count the full economic impact.** Direct, indirect and induced, with a stated boundary and source.
- **Blend revenue streams.** Balance predictable income against high-skew upside; equity is the riskiest.

- **Respect the time value of money.** Use ROI for communication, NPV and IRR for decisions.
- **Use locally relevant multipliers.** Never import a flattering figure from another context.
- **Track ventures by cohort.** Survival and growth over time, not a blended snapshot.
- **Report the distribution, not the average.** Licensing returns are dominated by rare blockbusters.
- **Treat intangible value honestly.** Proxies and narrative, never a spurious headline number.
- **Judge sustainability over the long run.** And against maturity; separate windfalls from recurring income.

Common economic-evaluation pitfalls and their fixes

Pitfall	Why it fails	Fix
Reporting only direct impact	Understates the true contribution	Add indirect and induced, with a source (2.1)
Using ROI on long projects	Ignores the time value of money	Use NPV / IRR for decisions (2.4)
Importing a high multiplier	Inflates impact; not locally valid	Use published, local multipliers (2.5)
Averaging license income	Hides the home-run skew	Report the distribution (2.7)
Spin-off snapshot count	Blends young and mature ventures	Use cohort survival analysis (2.6)
Monetizing brand value	Spurious precision; over claiming	Use proxies plus narrative (2.8)

Looking ahead

Lesson 3 takes the values established here ROI, economic impact, licensing returns, spin-off performance, sustainability together with the indicators of Lesson 1, and turns them into dashboards, executive briefs and impact narratives that drive decisions. The integrated practical assignment then runs the full chain KPIs, ROI, evaluation and reporting on a single technology transfer hub.

Economic Evaluation Toolkit

The templates below operationalize the lesson. They are written to be copied straight into a hub's practice or a Moodle resource.

Template 1 Return calculation worksheet

Use one worksheet per project or deal to compute and compare returns consistently.

Field	Guidance / worked entry
Investment (cost)	Total outlay, e.g. €200k (patent + incubation)
Cash inflows by year	List each year's income separately (timing matters)
Discount rate	Cost of capital / required return, e.g. 8%

Simple ROI	$(\text{total inflow} - \text{cost}) \div \text{cost} \times 100$
NPV	$\sum (\text{inflow}_{\text{year}} \div (1 + \text{rate})^{\text{year}}) - \text{cost}$
IRR	Rate at which NPV = 0 (compare to cost of capital)
Payback period	Year in which cumulative net first turns positive
Counterfactual note	What share would have happened anyway? (exclude it)
Sensitivity	Re-run at $\pm 2\%$ discount rate and $\pm 20\%$ benefits

Template 2 Which return measure should I use?

If the question is...	Use	Because
“Is the headline return good?” (quick comms)	ROI	Simple and intuitive, but ignores timing
“Does this create value today?” (decision)	NPV	Accounts for the time value of money
“What return rate does it earn?”	IRR	Comparable to the cost of capital
“How soon do we recover the outlay?”	Payback	Measures speed and short-term risk
“What is the social value?”	SROI (L1)	Monetizes social as well as financial outcomes

Glossary of Key Terms

Term	Definition
Cost-benefit analysis (CBA)	Comparing the discounted benefits of an activity against its costs.
Counterfactual	What would have happened without the project; only additional benefit counts.
Cost-recovery ratio	Earned income as a share of a TTO's operating cost.
Direct / indirect / induced	Impact of the firms themselves / their supply chains / re-spent wages.
Discounting	Converting future cash flows to present value using a discount rate.
Economic multiplier	Total economic impact expressed as a multiple of the direct effect.
Equity stake	Shares a hub holds in a spin-off, realized at an exit or IPO.
IRR	Internal Rate of Return, the discount rate at which NPV equals zero.
Milestone payment	A license payment triggered by a defined development step.
NPV	Net Present Value, the sum of cash flows discounted to today.
Payback period	The time taken to recover the initial investment.
ROI	Return on Investment net gain divided by cost, as a percentage.
Running royalty	A percentage of a licensee's product sales paid to the licensor.
Survival rate (cohort)	Share of a year's ventures still operating after a set period.

Lesson 3: Reporting and Executive Dashboards

Lesson overview. The final lesson turns measurements and economic evaluation into information that decision-makers can use. It covers audience needs, KPI dashboards, balanced scorecards, visualization, trend analysis, executive communication, impact reporting and data storytelling.

Learning outcomes

- Match reporting outputs to operational, managerial, executive and external audiences.
- Build KPI dashboards with targets, thresholds and alerts.
- Apply the Balanced Scorecard to technology transfer.
- Choose suitable visualizations and avoid common reporting errors.
- Use trend analysis to support evidence-based decisions.
- Communicate institutional and societal impact clearly.

Core topics

- From measurement to communication
- Reporting audience hierarchy
- KPI dashboards and performance monitoring
- Balanced Scorecard
- Data visualization
- Dashboard design and data governance
- Trend analysis
- Executive reporting
- Institutional and societal impact
- Data storytelling and case studies

Learning activity / reflection

Take a small KPI set and design a one-page executive dashboard. Add a target, current value, trend and recommended action for each KPI.

Lesson summary

A good report is decision-oriented: every number should have a clear meaning, a relevant audience and an implied or explicit action.

Lesson 3 at a Glance

Lessons 1 and 2 of this course built the measurement system. Lesson 1 defined *what we count*, the indicators, KPIs and frameworks that describe technology transfer activity. Lesson 2 established *what it is worth*, through ROI, IRR, cost–benefit analysis and economic-impact modeling. Lesson 3 addresses a different and frequently neglected question: **how those measurements are turned into decisions and into legitimacy**. This is the reporting layer, the point at which numbers either change behavior or quietly fail to.

The recurring failure in real technology transfer offices (TTOs) and innovation hubs is rarely an absence of data. It is the production of reports that are **data-rich but decision-poor**: crowded dashboards, vanity counts, no comparison to targets, and no clear action implied by any number on the page. Lesson 3 is therefore organized around a single discipline, every report exists to help

a specific audience make a specific decision, and around the craft needed to honor it: dashboards, visualization, the balanced scorecard, trend analysis, executive communication, impact reporting and data storytelling.

Learning outcomes

By the end of Lesson 3, participants will be able to:

1. Distinguish the reporting needs of operational, managerial, executive and external audiences, and design outputs appropriate to each.
2. Build and critique KPI dashboards, selecting leading and lagging indicators and setting targets, thresholds and alerts.
3. Apply the Balanced Scorecard to a technology transfer hub, translating strategy into a coherent set of objectives and measures.
4. Select appropriate data visualizations and apply core perceptual and design principles to avoid common reporting errors.
5. Design an executive dashboard for a TT hub, including its underlying data architecture and governance.
6. Use trend analysis to separate signal from noise and to trigger evidence-based decisions.
7. Communicate institutional and societal impact, including through SROI and impact narratives, to non-specialist stakeholders.
8. Construct a clear data story that carries an audience from context to recommended action.

How to use this lesson

Work through the nine topics in sequence; each builds on the previous one. Every topic ends with a **Knowledge check** box that previews the kind of question used in the module quiz, and most include a worked **Example** drawn from a realistic university or startup context. A running case, a mid-sized European TTO and an emerging Western-Balkans hub, is developed in Topic 9 so that the abstract principles land against concrete numbers. The lesson assumes the KPI vocabulary of Lesson 1 and the valuation methods of Lesson 2; where a term first appears it is also collected in the Glossary at the end.

Prerequisite link

Before starting, confirm you can define the following from Lessons 1 and 2: *invention disclosure, license vs. option, spin-off, ROI, IRR, SROI, economic multiplier*. Lesson 3 reports on these; it does not re-derive them.

3.1 From Measurement to Communication: The Last Mile

Measurement and communication are different activities with different failure modes. A measurement system can be technically excellent well-defined indicators, clean data, defensible valuations, and still produce no change in how an institution behaves. The gap between a correct number and a better decision is what this lesson calls the **last mile** of measurement. It is where most of the value of Lessons 1 and 2 is either realized or lost.

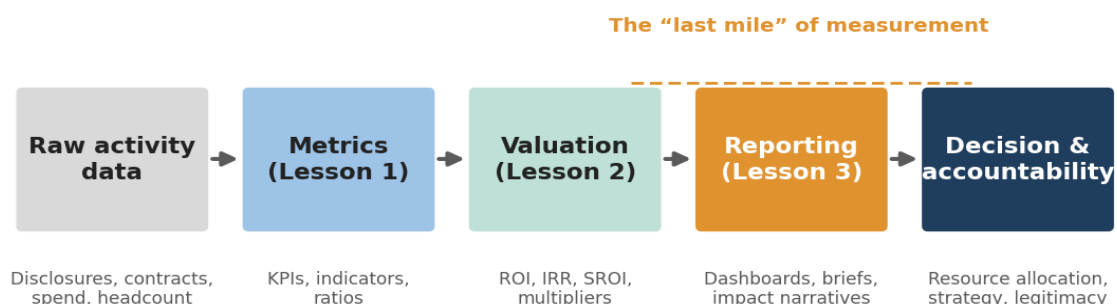


Figure 1. *The reporting value chain. Lesson 3 occupies the step where measured value becomes decisions and accountability.*

Reporting in a technology transfer context performs three distinct functions, and confusion between them is a common source of poor reports. The first is **steering**, giving managers and executives the information needed to allocate resources, adjust strategy and intervene in time. The second is **accountability** demonstrating to funders, government, university leadership and the public that resources entrusted to the hub have produced legitimate results. The third is **learning** building an institutional memory of what works, so that practice improves over cycles. A single report rarely serves all three well; effective reporting begins by naming which function is in play.

Why technology transfer reporting is unusually hard

Three structural features make TT reporting more difficult than ordinary management reporting, and each shapes the design choices that follow.

- **Long and uncertain lag.** The chain from an invention disclosure to a license, a product, and finally to economic and societal impact can take a decade or more. Outcome (lagging) indicators therefore arrive too late to steer current decisions, which forces a heavy reliance on leading indicators discussed in Topic 3.
- **Extreme skew.** Licensing returns follow a power law: a tiny number of deals account for the overwhelming majority of revenue. Reporting that leans on averages or totals can badly misrepresent the typical case, a point examined quantitatively in Topics 7 and 10.
- **Multi-dimensional value.** Success is financial, but also reputational, educational and societal. A report that shows only revenue understates the mission of most public research organizations and invites the wrong strategic conclusions.

Knowledge check 3.1

- Name the three functions of reporting (steering, accountability, learning) and give one TT example of each.
- Explain why a technically correct measurement system can still fail to improve decisions.
- Why does the long lag between disclosure and impact push reporting toward leading indicators?

3.2 The Reporting Audience Hierarchy

One idea organizes this entire lesson: that **reporting design is driven by audience, not by data availability**. The same underlying facts must be presented at very different levels of aggregation, on very different cadences, depending on who is reading and what decision they face. A useful model arranges audiences into four layers.



Figure 2. *The reporting audience hierarchy. Aggregation rises and granularity falls as reports move up the pyramid; cadence lengthens.*

- **Operational (TTO officers, IP and project staff).** Need case-level detail in near real time: which filings have deadlines this week, which agreements await signature, which invoices are overdue. Their reports are working tools, not summaries.
- **Managerial (TTO director, hub managers).** Need portfolio-level views on a monthly cadence: pipeline conversion, budget against plan, workload distribution, deals at risk. Their question is ‘where do I intervene this month?’
- **Executive (Rector, Vice-Rector for Research, board or senate).** Need strategic KPIs against targets on a quarterly cadence, with exceptions surfaced. Their question is ‘is the strategy working, and where is it off course?’ Detail beyond that is noise to them.
- **External (government, funders, industry partners, the public).** Need highly aggregated impact and accountability information, usually annually. Their question is ‘was this a good use of public and institutional resources?’

A frequent and costly mistake is to show an executive an operational report, a dense table built for a case officer, or to give a case officer a strategic summary that is useless for daily work. The rule of thumb is that as a report moves up the pyramid, the number of distinct figures on the page should *fall*, not rise, while each remaining figure should carry more meaning (a comparison to target, a trend, an exception flag).

Example: one metric, four reports

Consider a single fact license income of €1.92M year-to-date.

- **Operational:** a line-item ledger of each royalty receipt, payer, contract reference and due date.
- **Managerial:** income by faculty and by deal, with the three largest contributors and any payment in arrears flagged.
- **Executive:** a single KPI card €1.92M, ▲ 12% versus target, with a twelve-month trend line.
- **External:** a sentence in the annual report licensing returned nearly €2M to research this year set inside an impact narrative.

Two delivery modes serve these audiences. **Push** reporting sends a fixed report on a schedule, the quarterly board brief, the annual impact report, and suits external and executive audiences who need a curated, stable view. **Pull** reporting gives users a live, self-service dashboard they

interrogate on demand, suited to operational and managerial users who need current detail. Most hubs need both; problems arise when a push audience is handed a self-service tool they have no time to explore, or a pull user is starved of the live access they need.

Matching format and cadence to the audience

Audience determines not only what to report but in what **form** and how **often**. A useful distinction is between *push* reporting (a scheduled report sent to the audience) and *pull* reporting (a live dashboard the audience consults when it chooses). Operational teams are best served by frequent pull access to detail; a governing board is best served by an infrequent, highly distilled push report. Sending an operational data dump to a board, or asking operational staff to wait for a quarterly summary, are the two commonest mismatches.

Audience	Typical format	Cadence	Depth
Operational staff	Live dashboard, work queues	Daily / weekly (pull)	Full detail
Hub management	Dashboard + short commentary	Monthly	KPI level with drill-down
Executive leadership /	One-page brief + scorecard	Quarterly	Exceptions and decisions only
Board / funders	Narrative report + headline metrics	Annual	Impact and strategy

Two principles keep a reporting system coherent across these levels. The first is the **single source of truth**: every level should draw from the same underlying data so that the board's annual figure reconciles to the operational dashboard rather than contradicting it. The second is *consistency of definition* over time, so that a number means the same thing in this year's report as in last year's. When either breaks, audiences quickly lose trust in the whole system, and rebuilding that trust is far harder than maintaining it.

Knowledge check 3.2

- List the four audience layers and the typical reporting cadence for each.
- As reports move up the pyramid, should the number of figures rise or fall? Justify.
- Give an example of an audience-mismatch error and its likely consequence.

3.3 KPI Dashboards and Performance Monitoring

A dashboard is a single, consolidated visual display of the most important information needed to achieve one or more objectives, arranged so it can be monitored at a glance. The phrase 'at a glance' is the design constraint: a dashboard is not a report with charts, and not a data dump. Dashboards come in three types, and matching the type to the audience and decision is the first design choice.

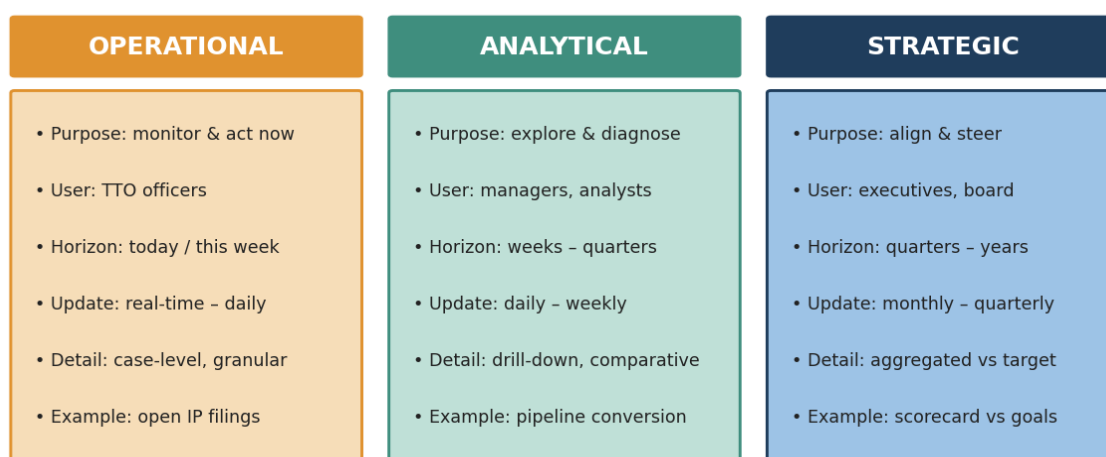


Figure 3. The three dashboard types. Each serves a different audience, horizon and update cadence; mixing their purposes produces cluttered, low-value displays.

Leading and lagging indicators

Because the impact of technology transfer materializes years after the activity that produced it, monitoring cannot rely on outcome measures alone. The pipeline below distinguishes **leading indicators** early, controllable signals that predict future results, from **lagging indicators**, which confirm results after the fact. A hub that watches only license income is steering by looking in the rear-view mirror; one that also watches disclosure volume and pipeline conversion can act a year or more earlier.

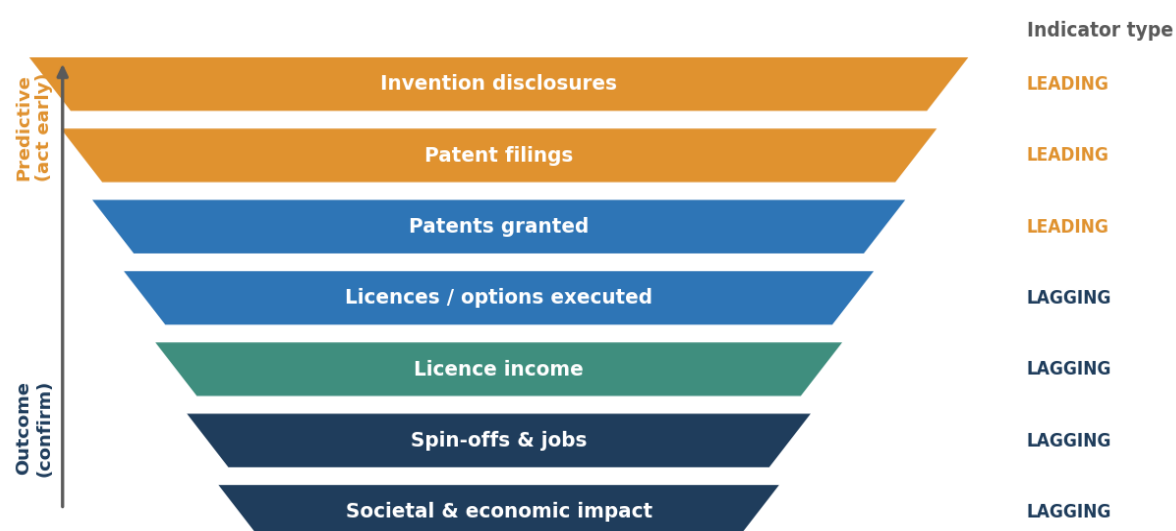


Figure 4. The commercialization pipeline, with leading indicators near the top (predictive, controllable) and lagging indicators near the bottom (confirmatory).

Targets, thresholds and alerts

A KPI without a target is only a number. Effective performance monitoring attaches to each KPI a **target** (the desired value), a **threshold** or tolerance band (how far off is acceptable), and an **alert rule** (what triggers attention). The widely used red-amber-green (RAG) convention encodes this: green within tolerance, amber drifting, red breached. RAG status is only as good as the thresholds

behind it, so thresholds should be agreed in advance and documented, not improvised when a number looks bad.

KPI	Type	Example target	Amber / Red trigger
Invention disclosures (YTD)	Leading	70 per year	< 90% / < 75% of pro-rata target
Pipeline conversion (disclosure → license)	Leading	≥ 12%	< 10% / < 7%
Median deal cycle time	Process	≤ 180 days	> 200 / > 250 days
License income	Lagging	€4.0M / year	< 90% / < 80% of target
Spin-offs created	Lagging	5 per year	< 4 / < 3 on plan
Active partner firms	Outcome	≥ 60	< 55 / < 45

Practitioner note: vanity vs. actionable metrics

A **vanity metric** rises reassuringly but implies no decision cumulative patents held, total website visits, lifetime disclosures. An **actionable metric** is tied to a target and a possible response. Before adding any KPI to a dashboard, ask: 'if this number turns red, what would we do differently?' If there is no answer, the metric belongs in an archive, not on a dashboard.

A practical test for any candidate KPI is whether it is **SMART** Specific, Measurable, Achievable, Relevant and Time-bound. A vague 'measure of innovation' fails the test; 'invention disclosures per 100 academic staff per year' passes it, because it is unambiguous, countable, comparable across units and bounded in time.

Three kinds of dashboard

'Dashboard' is not one thing, and matching the type to the purpose prevents most design failures. Convention distinguishes three. A **strategic** dashboard tracks progress against long-term goals for executives, updated infrequently and built around a small set of high-level KPIs. An **analytical** dashboard supports investigation comparisons, trends and drill-down for managers and analysts asking why a number moved. An **operational** dashboard monitors live activity (the deal pipeline, pending agreements) and is consulted frequently by the people doing the work. The common error is to build one dashboard and ask it to serve all three purposes, producing something too detailed for executives and too shallow for analysts.

Type	Primary user	Time focus	Question it answers
Strategic	Executives / board	Long-term	Are we meeting our goals?
Analytical	Managers / analysts	Past to present	Why did this change?
Operational	Front-line staff	Now / this week	What needs attention today?

For most technology transfer hubs the priority is the strategic dashboard for leadership and a lightweight operational view for the office itself; full analytical tooling matters only once data volume justifies it. Whichever the type, the design rule that the most important number occupies the position the eye reaches first (developed in Topic 3.6) holds throughout.

Knowledge check 3.3

- Define the three dashboard types and give the primary audience of each.

- Classify three TT metrics as leading or lagging and explain your reasoning.
- What three elements turn a raw KPI into a monitored KPI?
- Give an example of a vanity metric in a TTO and the actionable metric you would use instead.

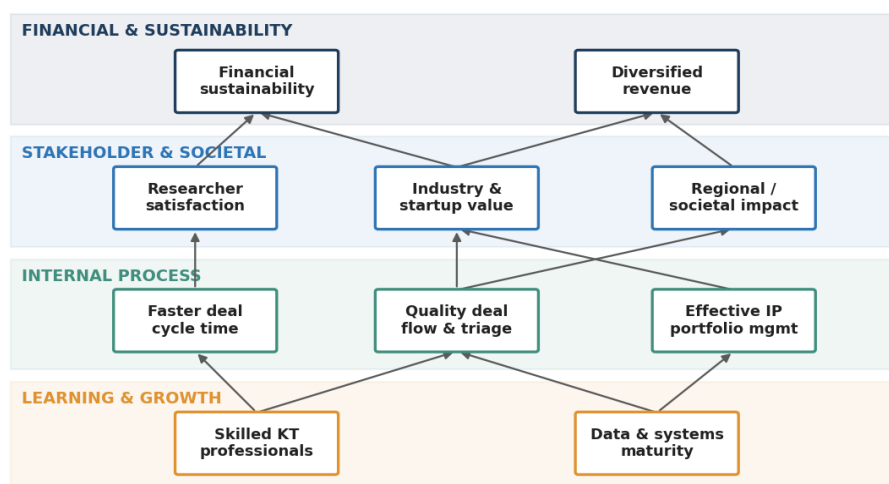
3.4 The Balanced Scorecard in Technology Transfer

Dashboards risk becoming a pile of disconnected numbers. The Balanced Scorecard (BSC), introduced by Kaplan and Norton, is a framework for keeping them connected to strategy. It insists that performance be viewed through several complementary perspectives rather than financial results alone, on the argument that financial outcomes are produced by earlier, non-financial drivers.⁶

Adapted to a public-mission technology transfer hub, the four perspectives become:

- **Financial & sustainability** can the hub fund itself and return value? Measures: license income, cost recovery ratio, diversification of revenue, reserves.
- **Stakeholder & societal** does the hub create value for researchers, industry, startups and society? Measures: researcher satisfaction, partner retention, jobs in spin-offs, regional impact. (In a public university this perspective often outranks the financial one.)
- **Internal process** are core processes efficient and high-quality? Measures: deal cycle time, triage quality, IP portfolio cost-effectiveness.
- **Learning & growth** is the hub building the people, systems and culture for future success? Measures: staff KT qualifications, data-systems maturity, training delivered.

The power of the BSC is the **strategy map**: a causal chain showing how investment in learning and growth improves internal processes, which creates stakeholder value, which sustains the finances. It makes the institution's implicit theory of how it succeeds explicit and testable.



⁶Kaplan, R. S. & Norton, D. P. (1992), 'The Balanced Scorecard — Measures That Drive Performance', Harvard Business Review.

Figure 5. A Balanced Scorecard strategy map for a technology transfer hub. Arrows express hypothesized cause and effect from the foundational perspective (bottom) upward to financial sustainability.

Note that the public-mission ordering inverts the classic corporate version. For a private firm the financial perspective sits at the top as the ultimate goal; for a university TTO, financial sustainability is usually a *means* to the societal mission rather than the end in itself, and many hubs place stakeholder and societal value at the apex. The framework is the same; the ranking reflects the mission.

Knowledge check 3.4

- Name the four Balanced Scorecard perspectives and give one TT measure for each.
- What is a strategy map and what does it make explicit?
- Why might a public university TTO place the stakeholder/societal perspective above the financial one?

3.5 Data Visualization for Innovation Management

A chart is an argument made with position, length and color. Because human perception decodes some visual properties far more accurately than others, the choice of encoding is not cosmetic it determines whether the audience reads the data correctly or is misled. Two principles do most of the work.

- **Match the chart to the question.** Most analytical questions reduce to one of a few types comparison, trend over time, part-to-whole composition, or relationship between variables, and each type has a small set of appropriate chart forms.
- **Maximize the data-to-ink ratio.** Every element that does not carry information heavy gridlines, 3-D effects, decorative shading, redundant legends competes with the data for the reader's attention. Remove it.

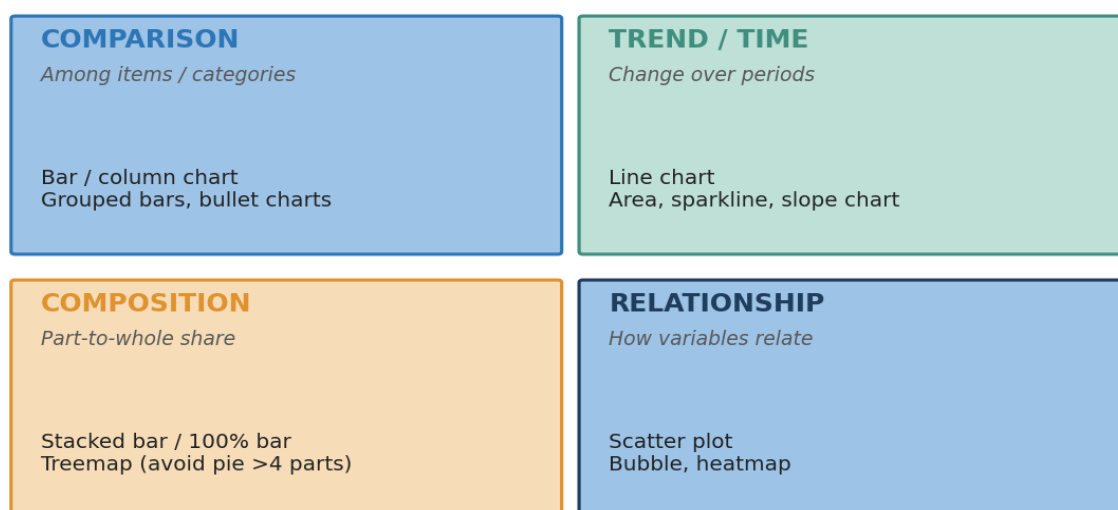


Figure 6. A chart-selection matrix. Identify the question type first, then choose among the appropriate chart forms; this prevents the reflexive overuse of pie and 3-D charts.

The principles behind good visualization

Effective visualization is not decoration; it exploits how human perception works. Certain visual properties position, length, and to a lesser extent slope are read **pre-attentively**, almost instantly and accurately, while others area, angle, and color shade are read slowly and imprecisely. This is the perceptual reason a bar chart (which encodes value as length and position) is read more accurately than a pie chart (which encodes value as angle and area), and why a single highlighted figure registers before any surrounding text. Designing a chart is largely a matter of mapping the most important comparison onto the most accurately perceived channel.

Chart choice should follow the **type of comparison**, not habit or novelty. The table below pairs common reporting questions with the chart that answers them most honestly.

To show...	Use	Avoid
A value over time	Line chart	3-D or area pile-ups
Ranking across categories	Horizontal bar chart	Pie chart
Part-to-whole (few parts)	Stacked bar or simple split	Many-slice pie
Distribution / skew	Histogram or sorted bars	A single average
Status against target	Bullet bar or RAG	Gauge 'speedometers'

Three further disciplines mark professional work. Maximize the *data-to-ink ratio* by removing gridlines, borders and decoration that carry no information. Use *color* sparingly and purposefully one accent to direct attention, never a rainbow and check that the palette remains legible for color-blind readers, since red-green status coding fails for a substantial minority unless shape or label reinforces it. And label directly where possible rather than forcing the reader back to a legend. The aim throughout is that the chart's meaning arrives before the reader consciously studies it.

Common visualization errors in TT reporting

1. Pie charts with many slices.
2. Truncated or dual axes that exaggerate change or imply false correlation.
3. Color used decoratively rather than to encode meaning, and palettes that fail for color-blind readers (avoid red/green as the sole distinction).
4. 3-D effects, which distort the very lengths and areas the reader is meant to compare.
5. Showing totals where rates or per-unit figures are needed, a larger university will always have more disclosures; disclosures per million euros of research expenditure is the comparable measure.

Two quick disciplines prevent most errors. First, label directly on the data where possible rather than forcing the eye to a distant legend. Second, state the **take-away in the title**: 'License income up 12% on target' is a far more useful chart title than 'License income', because it tells the reader what they are meant to conclude.

Example: redesigning a weak chart

Original: a 3-D pie chart splitting license income across eight faculties, with a color legend down the side.

Problems: eight slices exceed what a pie can convey; the 3-D effect distorts the very areas being compared; the legend forces the eye back and forth; and the chart states no conclusion.

Redesign: a horizontal bar chart sorted largest-to-smallest, faculties labelled directly on the bars, one accent color highlighting the leading contributor, and a title that states the point 'Three faculties generate 70% of license income'.

Knowledge check 3.5

- For each question type comparison, trend, composition, relationship name an appropriate chart.
- Explain the data-to-ink ratio and give two ways to improve it.
- Why is 'disclosures per million euros of research spend' often better than 'total disclosures' for comparison?
- Identify two reasons to avoid relying on red/green color coding alone.

3.6 Dashboard Design for Technology Transfer Hubs

This topic synthesizes the previous three into a single artifact: an executive dashboard for a TT hub. Good dashboard layout follows the way people read, an **inverted pyramid** in which the most important, most aggregated information sits top-left (where the eye lands first), with supporting detail below and to the right. A useful test is the **five-second rule**: a competent reader should grasp overall status within five seconds and only then drill into specifics.

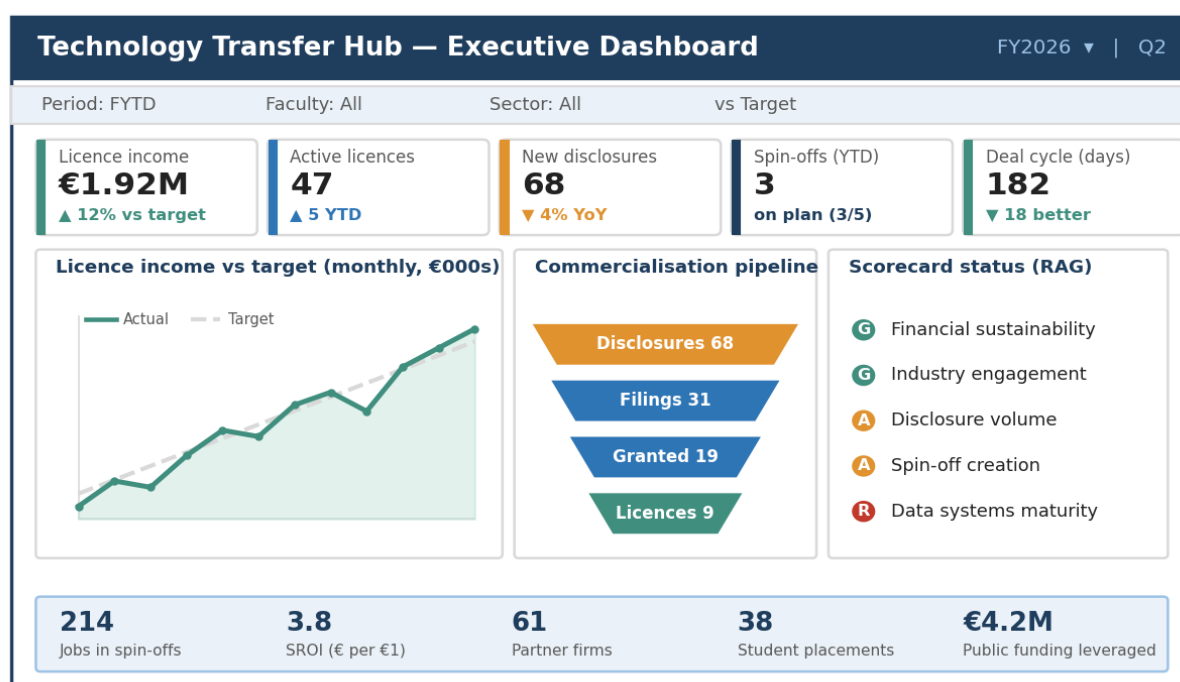


Figure 7. Worked example, an executive dashboard for a technology transfer hub. KPI cards (status at a glance) sit above a trend chart, a pipeline funnel and a RAG scorecard, with an impact strip anchoring the view.

The wireframe above illustrates several principles working together:

- **KPI cards** carry the headline numbers, each with a comparison to target or prior period, a number without a comparison is not yet information.
- **A single trend chart** provides direction and momentum, with the target shown as a reference line.

- **A pipeline funnel** exposes conversion and bottlenecks, linking leading to lagging indicators.
- **A RAG scorecard** surfaces exceptions, the executive eye is drawn to the single red item (data-systems maturity) without reading every line.
- **An impact strip** keeps the mission in view, ensuring the hub is never judged on revenue alone.

What sits behind a dashboard: data architecture and governance

A dashboard is the visible tip of a data pipeline. Its credibility depends entirely on the layers beneath it. The most common cause of a discredited dashboard is not poor charts but inconsistent definitions, two departments counting 'spin-offs' differently, or 'license income' including or excluding reimbursements. The semantic layer exists precisely to prevent this.

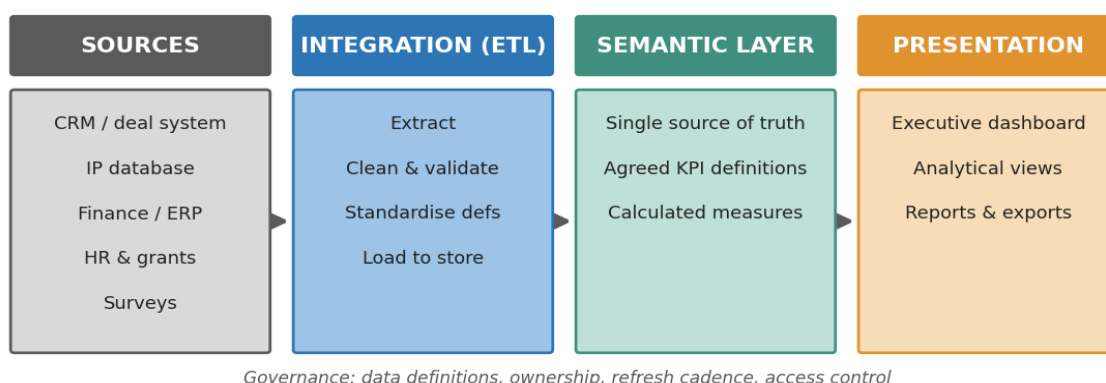


Figure 8. The data architecture behind a dashboard. A semantic layer enforcing agreed KPI definitions is what makes numbers trustworthy and comparable across the institution.

Tooling follows architecture, not the other way round. Common platforms include Microsoft Power BI, Tableau and the free Looker Studio for visualization; spreadsheets remain entirely adequate for a small or new hub. The choice matters far less than three governance commitments: a **single source of truth** with documented definitions, named **data owners** responsible for each source, and an agreed **refresh cadence** so that everyone knows how current the figures are.

Design checklist

- Does every number carry a comparison (target, prior period, or peer)?
- Can overall status be read in five seconds?
- Is each chart the right form for its question (Topic 5)?
- Are definitions documented and consistent across sources?
- Is there a single owner and a known refresh date for every data feed?
- Have you removed every element that carries no information?

Knowledge check 3.6

- Explain the inverted-pyramid layout and the five-second rule.
- Name the four layers of a dashboard data architecture and the role of the semantic layer.
- Why is a number without a comparison 'not yet information'?
- List the three governance commitments that matter more than tool choice.

3.7 Trend Analysis and Decision-Making

Single-period figures are dangerous because technology transfer data is noisy: a quarter's license income can swing on the timing of one milestone payment. Trend analysis is the discipline of separating **signal** (a real, sustained change) from **noise** (ordinary period-to-period variation), so that decisions respond to the former and ignore the latter.

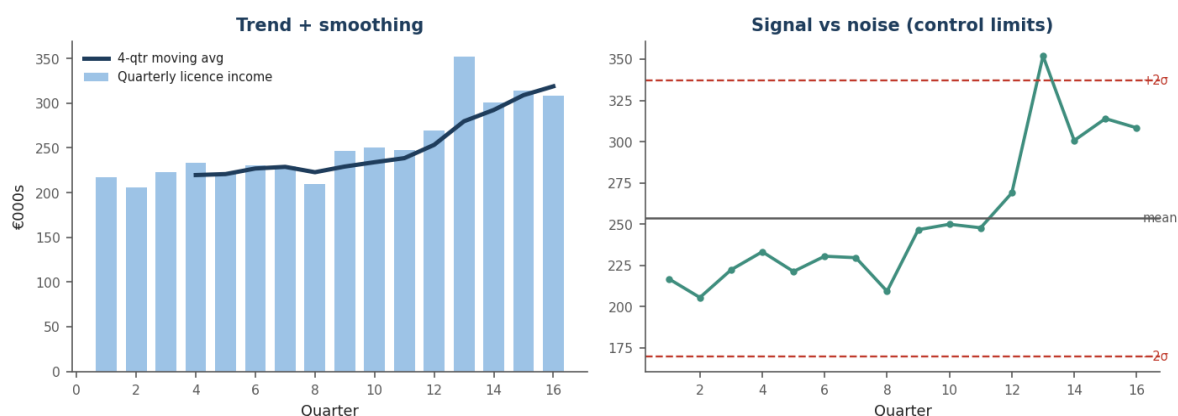


Figure 9. Left: a moving average smooths quarterly noise to reveal the underlying trend. Right: control-style limits (mean $\pm$ 2 standard deviations) distinguish a genuine signal from routine variation.

Three techniques are sufficient for most TT reporting:

- **Moving averages** smooth short-term volatility (a four-quarter average is common) so that the direction of travel is visible.
- **Control limits**, a mean with upper and lower bounds prevent over-reaction. A point inside the band is noise; a point outside, or a run of points trending one way, is a signal that warrants investigation.
- **Cohort (vintage) analysis** groups deals or spin-offs by the year they were created and tracks each cohort over time, the honest way to ask 'are the spin-offs we created three years ago still alive and growing?' rather than blending young and mature ventures into one misleading average.

Methods for reading a trend honestly

A line that goes up is not automatically good news, and separating signal from noise takes method. The first discipline is to distinguish a **real movement** from ordinary variation: with the small, lumpy numbers typical of technology transfer, a single year's rise or fall is often noise. A *moving average* (say a three-year rolling mean) smooths this lumpiness and reveals the underlying direction, which is usually the more honest thing to report than a volatile year-on-year figure. Where a series has a regular cycle grant rounds, academic-year effects *seasonality* should be acknowledged so that a predictable dip is not misread as decline.

Three further habits separate analysis from anecdote. Always compare against a stated **baseline** (the prior period, a target, or a peer figure), since a number without a reference point carries no meaning. Distinguish a *level* from a *rate of change*: income can be low yet growing fast, which is the characteristic and easily-missed signal of a healthy emerging hub. And resist reading **causation** into a correlation disclosures and income may rise together because both follow research funding, not because one causes the other. The reporting goal is not to make the trend look good but to say, accurately, which way it points and how confident we can be.

From insight to decision

Trend analysis earns its place only when it changes a decision. A practical bridge is the **decision trigger**: agree in advance that a defined pattern prompts a defined response, for example, ‘two consecutive quarters of disclosure volume below the lower control limit triggers a review of researcher engagement’. This converts monitoring into management and removes the temptation to rationalize away bad signals.

Benchmarking and the comparability problem

Trends within a hub answer ‘are we improving?’; benchmarking against peers answers ‘are we competitive?’. European benchmarking data is published through the annual knowledge-transfer survey coordinated by ASTP and related bodies, but it must be used with care. Definitions still vary across countries some count a spin-off at incorporation, others at the date of the IP agreement; the term ‘spin-off’ itself competes with ‘spin-out’ and ‘start-up’ across jurisdictions.⁷ A European harmonized-metrics framework, developed by the Joint Research Centre with ASTP, separates input, output and impact indicators precisely to make such comparisons meaningful.⁸ The practical rule: benchmark against institutions of similar mission, size and research intensity, and always confirm that a metric is defined the same way before comparing it.

Example: a decision trigger in practice

Rule, agreed in advance: *‘Two consecutive quarters with disclosure volume below the lower control limit trigger a researcher-engagement review.’*

Q1 falls below the limit and is treated as noise, no action. Q2 also falls below, the trigger fires and the review is launched, well before a full year of weak pipeline locks in lower license income two years downstream. The trigger turns a worrying chart into a scheduled management action and removes the temptation to explain the dip away.

Knowledge check 3.7

- Distinguish signal from noise and name a technique for separating them.
- What is a decision trigger and why is it agreed in advance?
- Why is cohort analysis more honest than a single blended average for spin-off survival?
- Give two reasons cross-country TTO benchmarking can mislead if definitions are not checked.

3.8 Executive Reporting and Strategic Communication

Executives are time-poor and decision-focused. Executive reporting is the art of compressing a quarter of activity into something that can be absorbed in minutes and acted on with confidence. The governing format is the **one-page brief** (or a single dashboard view) built on a simple structure: status, exceptions, decisions required.

A reliable executive brief answers four questions in order:

1. Where are we against our goals?

⁷ASTP, reporting on cross- jurisdiction differences in knowledge- transfer metric definitions (spin- off vs spin- out; counting at incorporation vs IP- agreement date), astp4kt.eu.

⁸European Commission Joint Research Centre with ASTP (Campbell et al., 2020), harmonized input/output/impact knowledge- transfer metrics framework.

2. What changed, and is it signal or noise?
3. What needs a decision, and what are the options?
4. What do we recommend, and what do we need from you?

The discipline that distinguishes executive communication from mere reporting is the **so what**. Every figure presented to an executive should be one step from an implication. 'Disclosure volume fell 4% year-on-year' is data; 'disclosure volume fell 4%, concentrated in the engineering faculty, suggesting our new outreach has not reached them we recommend a targeted program' is communication. The numbers earn attention; the interpretation earns the decision.

Example: the quarterly board brief (structure)

Headline (1 line): "FYTD on track overall; disclosure pipeline is the watch item."

Status (KPI cards): income €1.92M (▲12% vs target), 3 of 5 spin-offs on plan, deal cycle improved 18 days.

Exceptions: disclosures -4% YoY (amber); data-systems maturity red reporting still partly manual.

Decision required: approve €40k to complete the deal-management system; expected payback via staff time saved within 14 months.

Cadence and consistency matter as much as content. A brief that arrives on the same schedule, in the same structure, every quarter builds executive trust and reading fluency; a report whose format changes each time forces re-learning and erodes confidence in the figures.

Structuring the message: lead with the answer

Executive communication inverts the structure of academic writing. A research paper builds from background through method to a conclusion at the end; an executive brief must put the **conclusion first**. This is the 'bottom line up front' (BLUF) discipline, and the related *pyramid principle* (Barbara Minto): state the recommendation, then the few reasons that support it, then the evidence beneath each reason, so a reader can stop at any level and still have the answer. An executive who reads only the first sentence should already know what you are asking them to decide.

A reliable one-page structure follows from this: a one-line *situation*, the *recommendation* or headline finding, three or four *supporting points* each with its key number, and a clear *ask* (the decision required). Everything else method, full tables, caveats belongs in an appendix the reader can consult but need not read. The most common executive-reporting failure is the reverse: a careful build-up that buries the recommendation in the final paragraph, where a busy reader never reaches it.

Section	Length	Purpose
Situation	1 line	Why this brief, now
Recommendation / finding	1–2 lines	The decision or headline, up front
Supporting points	3–4 bullets	Each a reason plus its key figure
The ask	1 line	Exactly what is needed from the reader
Appendix	As needed	Detail for those who want it

Knowledge check 3.8

- What four questions should an executive brief answer, in order?

- Explain the 'so what' test and rewrite a raw data statement to pass it.
- Why do consistent cadence and structure increase the value of executive reporting?

3.9 Reporting Institutional and Societal Impact

For most universities and public research organizations, financial return is not the primary mission it is a means to research, education and public benefit. Reporting that stops at revenue therefore understates the institution's real contribution and invites the wrong strategic conclusions. Impact reporting extends the picture to the economic, social and educational value created, and is increasingly demanded by the governments and funders to whom hubs are accountable.

Frameworks for an impact case

Reporting impact credibly means showing the **chain** from activity to effect, not asserting the effect directly. The standard scaffold is the impact value chain inputs lead to activities, then outputs, then outcomes, then impact the same ladder introduced in Lesson 1. Its reporting value is that it lets a hub claim only as far along the chain as its evidence reaches: outputs are firmly attributable, outcomes need a plausible link, and societal impact is shared with many other causes. A report that explicitly says 'here is our output, here is the outcome we contributed to, here is the wider impact we are part of' is far more credible than one that leaps straight from a patent count to regional prosperity.

This is the distinction between **attribution** (the effect was caused by us) and **contribution** (we were one of several causes). For most societal impact, an honest report claims contribution, not attribution, and says so. Two complementary forms then carry the case: a small number of robust *quantitative* indicators (jobs, an SROI ratio with its assumptions stated), and a concrete *narrative* example a specific technology, the people it reached, the change it made. The number establishes scale; the story establishes meaning. Neither alone persuades a board: figures without a story feel abstract, and a story without figures feels anecdotal.

Chain stage	Claim strength	Example
Output	Strong (attributable)	12 licenses executed
Outcome	Moderate (contribution)	Licensed product reached patients
Impact	Shared (one of many causes)	Improved regional health / growth

The impact logic model and SROI

Impact is best reported through a **logic model** that traces a clear chain from the resources invested to the ultimate effect on society. Distinguishing the links in this chain prevents the common error of reporting *outputs* (patents, licenses) as though they were *impact* (growth, welfare, progress against societal goals).

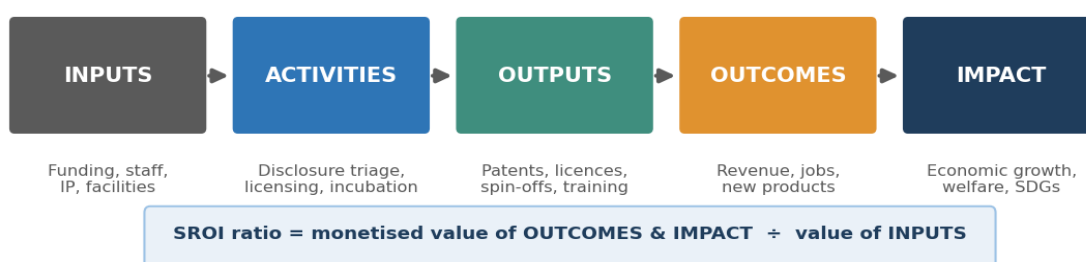


Figure 10. *The impact logic model. Social Return on Investment (SROI) monetizes outcomes and impact and expresses them as a ratio to the inputs invested.*

Social Return on Investment, introduced in Lesson 1, expresses monetized social value as a ratio to investment, an SROI of 3.8 means that each euro invested generated €3.80 of social value. SROI is powerful for communicating with non-specialist stakeholders, but its figures rest on valuation assumptions that must be stated transparently; an undisclosed assumption turns a persuasive ratio into a credibility risk.

Quantitative impact plus the narrative impact case

Numbers alone rarely convey societal impact convincingly, because the most important effects, a diagnostic that reaches patients, a regional cluster of new firms resist full quantification. Mature systems therefore pair metrics with structured **impact case narratives**: a short, evidenced account of a specific transfer, who benefited and how. The combination, a credible number anchored by a concrete story, is far more persuasive to a minister or funder than either alone. Typical external-impact measures include jobs created in spin-offs, follow-on investment leveraged, public funding attracted, products reaching market, and contribution to defined societal or sustainability goals.

Knowledge check 3.9

- Distinguish outputs from impact and give a TT example of each.
- Interpret an SROI of 3.8 and state the main caveat when reporting it.
- Why pair quantitative impact measures with narrative impact cases?
- List three external-facing impact measures suitable for an annual report.

3.10 Storytelling through Innovation Data

Data storytelling is the deliberate combination of data, visuals and narrative to drive understanding and action. It is not decoration and not spin; it is the recognition that audiences remember and act on stories far more than on tables. A well-told data story carries the audience along a familiar arc.



Figure 11. The data storytelling arc. Context establishes the stakes, a complication exposes a gap, the insight delivers the 'so what', and the resolution states the recommended action.

The arc maps directly onto reporting: **context** (where the hub stands and why it matters), **complication** (the gap or tension the data reveals), **insight** (the turn, the 'so what'), and **resolution** (the recommended action and the ask). The numbers are carried by the story rather than dumped as a table.

Why averages lie: the skew that demands a story

The clearest illustration of why technology transfer needs storytelling rather than raw aggregates is the extreme skew of licensing returns. Stanford's landmark Cohen–Boyer recombinant-DNA patents were licensed non-exclusively to several hundred companies and earned roughly **\$255 million** over the life of the patents, yet about four-fifths of that revenue came from a small handful of products.⁹ A licensing portfolio is typically dominated by a few rare 'home runs' in this way, which is exactly why an 'average license' figure computed across the portfolio is close to meaningless; the story is in the distribution.

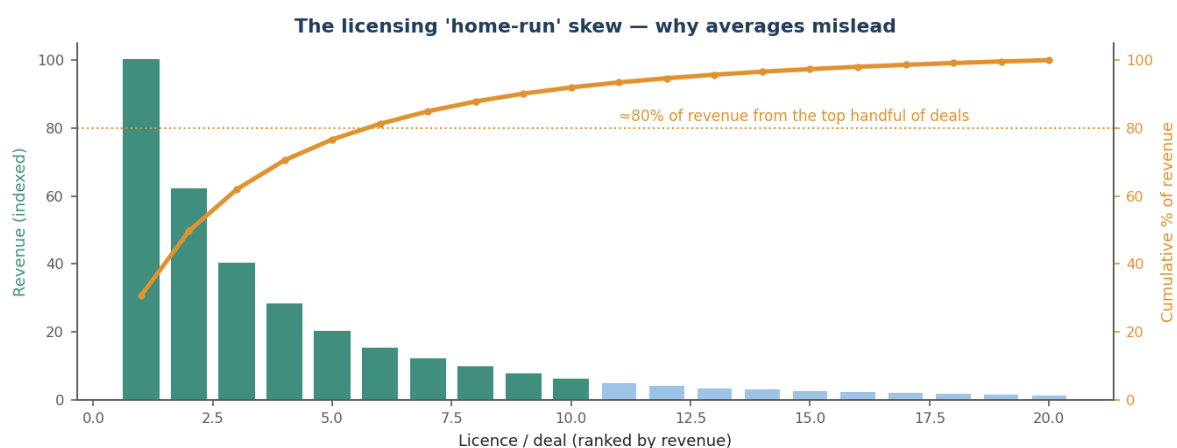


Figure 12. The licensing 'home-run' skew. A few deals (highlighted) account for the great majority of revenue; reporting the mean or total alone hides the pattern that actually matters for strategy.

⁹Feldman, Colaianni & Liu (2007) on the Stanford Cohen–Boyer program: non- exclusive licenses to several hundred companies; total revenue of roughly \$255 million over the life of the patents, with about 80% of revenue originating from a small number of products.

The reporting lesson is twofold. First, **show the distribution**, not just the total or the mean, so that decision-makers understand that the portfolio depends on rare large successes. Second, **set realistic expectations**: a hub whose strategy assumes every deal will be a Cohen–Boyer is misreading its own data. Honest storytelling about skew protects a hub from both over-promising to funders and mis-allocating effort internally.

Ethics of data storytelling

Storytelling can persuade, which makes honesty a professional obligation. Never truncate an axis to dramatize a trend, cherry-pick a flattering period, or present an outlier as typical. The aim is to make true things *clear and memorable*, not to make convenient things seem true.

Knowledge check 3.10

- Name the four stages of the data storytelling arc and what each contributes.
- Using the licensing skew, explain why an ‘average license value’ can mislead.
- State two reporting responses to a heavily skewed revenue distribution.
- Give two practices that cross the line from storytelling into dishonest presentation.

3.11 Case Studies in Technology Transfer Reporting

The two cases below are deliberately contrasting: a mature, world-class European TTO, and an emerging regional hub of the kind found across the Western Balkans. The contrast is the point reporting must fit the maturity and mission of the institution, and the metrics that define success at one stage are not those of the other.

Case A KU Leuven Research & Development (LRD), Belgium

LRD, founded in 1972, is one of Europe’s oldest and most successful technology transfer offices. Its publicly reported figures for 2025 illustrate the scale and shape of a mature operation: **3,142** new collaboration agreements with industry and other partners, **102** new patents, license income of **€152.6 million**, and **10** new spin-offs in the year bringing the cumulative total of spin-offs created since the early 1980s to **199**.¹⁰ The operation is supported by roughly forty innovation managers organized in thematic domains.

Several reporting lessons follow directly from the case:

- **Report the full portfolio of channels.** LRD’s headline is not a single revenue figure but a balanced set collaboration agreements, patents, license income and spin-offs, reflecting that value is created through several channels, not one.
- **Cumulative and annual figures answer different questions.** Ten spin-offs this year is a flow (current performance); 199 since the 1980s is a stock (long-run institutional impact). A good report shows both and does not confuse them.
- **Mature hubs still depend on rare large successes.** Even at this scale, the skew lesson of Topic 10 applies; reporting that hides the distribution would misrepresent the risk profile.

Case B “Tetova Regional Innovation Hub” (illustrative, Western Balkans)

Consider a young hub attached to a regional university, in its third year of operation, with a small team and modest budget. Annual figures might read: 22 invention disclosures, 6 patent filings, 2

¹⁰KU Leuven Research & Development (LRD), research figures for 2025, research.kuleuven.be.

licenses/options signed, €85,000 in license and service income, 1 spin-off created, and 14 industry collaboration agreements. Measured against KU Leuven's license income, the hub looks negligible, which is exactly why a mature hub's scorecard would be the wrong report to give it.

For an emerging hub, effective reporting differs in three ways:

1. Lead with leading indicators.
2. Use ratios and growth rates, not absolute totals.
3. Foreground non-financial and capacity outcomes.

In concrete terms: because lagging revenue is still small and volatile, the hub should foreground disclosure growth, researcher engagement, pipeline conversion and partnerships, the leading signals that predict whether the later revenue will ever materialize. It should report *growth* (disclosures up 45% on the prior year) rather than a small absolute number, and it should give prominence to capacity-building outcomes, staff trained, systems established, first partnerships, that a mature hub takes for granted. Judging it on absolute license income against KU Leuven's would tell leadership nothing useful; its conversion rate and growth trajectory against peer hubs of similar age and size will.

Reporting choice	Mature hub (KU Leuven)	Emerging hub (illustrative)
Headline emphasis	License income, spin-off stock	Disclosure growth, pipeline, partnerships
Indicator balance	Lagging outcomes dominate	Leading indicators dominate
Framing	Absolute totals	Growth rates and ratios
Benchmark against	Top global research universities	Peer hubs of similar age / size
Impact story	Decades of spin-offs and products	Capacity built, first wins, momentum

Knowledge check 3.11

- Why would a mature hub's scorecard be the wrong report for an emerging hub?
- Distinguish a flow metric from a stock metric using the spin-off figures.
- Name the three ways emerging-hub reporting should differ from mature-hub reporting.
- Why is conversion rate a fairer cross-hub comparison than absolute license income?

3.12 Summary and Key Takeaways

Lesson 3 has treated reporting as the last mile of measurement, the stage at which the indicators of Lesson 1 and the valuations of Lesson 2 either change decisions and earn legitimacy, or fail to. The through line has been a single discipline: **every report exists to help a specific audience make a specific decision**. Everything else dashboards, the balanced scorecard, visualization, trend analysis, storytelling, is craft in service of that discipline.

The essential points to carry forward:

- **Design for the audience, not the data.** Aggregate upward through the operational–managerial–executive–external hierarchy; fewer, more meaningful figures as you rise.
- **Watch leading indicators.** Because impact lags activity by years, early signals disclosures, conversion, engagement, are what allow timely action.

- **Connect metrics to strategy.** The Balanced Scorecard and its strategy map keep a dashboard from becoming a pile of disconnected numbers.
- **Make every number carry a comparison.** Target, prior period or peer, a bare number is not yet information.
- **Trust the trend, not the point.** Smooth noise, set control limits and decision triggers, and benchmark only against truly comparable definitions.
- **Report impact, not just income.** Use the logic model, SROI and narrative impact cases to reflect the full public mission.
- **Show the distribution.** Licensing returns are extremely skewed; averages and totals hide the pattern that matters.
- **Tell the truth, clearly.** Storytelling makes true things memorable; it must never make convenient things seem true.

Common reporting anti-patterns and their fixes

Anti-pattern	Why it fails	Fix
Data dump	Too many figures, no priority or implied action	Aggregate for the audience; lead with exceptions
Number without comparison	Reader cannot judge good from bad	Add a target, prior period or peer benchmark
Reacting to a single point	Mistakes ordinary noise for a real signal	Use moving averages and control limits
Totals only	Hides skew and institution-size effects	Show the distribution and per-unit ratios
Outputs shown as impact	Overstates the true contribution	Use the logic model; separate the two
Format changes each cycle	Erodes trust and reading fluency	Fix a consistent structure and cadence

Looking ahead: the integrated practical assignment

The course concludes with one integrated, step-by-step practical activity spanning all three lessons defining KPIs (Lesson 1), analyzing commercialization performance and calculating ROI indicators (Lesson 2), and preparing an evaluation report and executive dashboard for a technology transfer hub (Lesson 3). The reporting and dashboard stages of that assignment apply the methods developed in this lesson directly.

Reporting Toolkit: Reusable Templates

The templates below are written to be copied directly into a hub's reporting practice or a Moodle resource. Each operationalizes a principle developed earlier in the lesson.

Template 1 KPI definition sheet

Complete one sheet for every KPI before it appears on any dashboard. Documenting definitions in advance is what makes the semantic layer of Topic 6 possible and prevents the 'two departments, two definitions' failure.

Field	Guidance / worked example
KPI name	Median license deal cycle time
Definition & formula	Median calendar days from negotiation start to signature, across deals closed in the period
Type	Process indicator (leading for revenue)
Source system	Deal-management / CRM
Data owner	TTO operations manager
Target	≤ 180 days
Amber / Red thresholds	> 200 days / > 250 days
Refresh cadence	Monthly
Decision if breached	Trigger a pipeline review; reallocate officer capacity

Template 2 Executive one-page brief skeleton

Section	What goes here
Headline (1 line)	Overall status in plain language, the single sentence an executive would repeat
Status	Three to five KPI cards, each with a comparison to target or prior period
Trend	One chart showing the direction of travel, with a target reference line
Exceptions	Only the amber and red items, what is off course and why (signal, not noise)
Decision required	The specific choice needed, with options and trade-offs
Recommendation & ask	What you advise, and what you need from the board

Template 3 Dashboard build checklist

1. Name the audience and the single decision the dashboard must support.
2. Choose the dashboard type: operational, analytical or strategic.
3. Select five to nine KPIs, balancing leading and lagging; reject vanity metrics.
4. Define each KPI on a definition sheet (Template 1).
5. Set targets, tolerance thresholds and RAG rules in advance.
6. Lay out top-left to bottom-right by importance; apply the five-second rule.
7. Choose the right chart for each question (Topic 5); maximize the data-to-ink ratio.
8. Confirm a single source of truth, named data owners and a refresh cadence.
9. Add an impact strip so the mission stays visible alongside the finances.
10. Test with a real user; remove anything that carries no information.

Glossary of Key Terms

Term	Definition
Actionable metric	A measure tied to a target and a possible response; contrast with a vanity metric.

Balanced Scorecard (BSC)	A framework viewing performance through financial, stakeholder, internal-process and learning-and-growth perspectives.
Cohort (vintage) analysis	Grouping deals or ventures by creation year and tracking each group over time.
Control limits	Statistical bounds (often mean $\pm$ 2 standard deviations) distinguishing signal from routine variation.
Dashboard	A consolidated visual display of the key information needed to monitor objectives at a glance.
Data-to-ink ratio	The proportion of a chart's visual elements that actually encode data; higher is better.
Decision trigger	A pre-agreed rule by which a defined data pattern prompts a defined response.
Impact logic model	The chain inputs $\rightarrow$ activities $\rightarrow$ outputs $\rightarrow$ outcomes $\rightarrow$ impact used to structure impact reporting.
Leading indicator	An early, controllable signal that predicts future results (e.g. disclosures).
Lagging indicator	A measure that confirms results after the fact (e.g. license income).
RAG status	Red-amber-green coding of a KPI against its thresholds.
Semantic layer	The layer enforcing agreed, single-source KPI definitions beneath a dashboard.
SROI	Social Return on Investment monetized social value expressed as a ratio to investment.
Strategy map	A causal diagram linking Balanced Scorecard objectives across perspectives.
Vanity metric	A figure that rises reassuringly but implies no decision.

Practical Assignment (Chapter 2)

Measuring Technology Transfer Success: Economic Impact, KPIs and Evaluation

Tech2Link Project - Course 2

INTEGRATED PRACTICAL ASSIGNMENT

Evaluating a Technology Transfer Hub, End to End

Capstone exercise spanning Lessons 1–3

Faculty of Business and Economics, South East European University (SEEU)

Estimated effort: 4–6 hours • Weight: capstone • Submission via Moodle

Version 1.0

About this assignment

This capstone runs the whole course on a single case. You will take one technology transfer hub from raw indicators through to a finished executive report, applying the methods of all three lessons in sequence: **define and classify the right KPIs** (Lesson 1), **value the economic outcomes** (Lesson 2), and **report the result so it drives a decision** (Lesson 3). The three parts use the same dataset, so each builds directly on the one before.

The hub below is illustrative and constructed for teaching; the figures are realistic but not drawn from a real institution. Work with the numbers as given.

How this assignment works read first

This is **one assignment**, not three. You analyze a single technology transfer hub (introduced overleaf) and complete **three connected parts** Part A uses Lesson 1, Part B uses Lesson 2, Part C uses Lesson 3 then submit **one document** containing all three. Each part builds on the one before, so do them in order.

Your single submission must contain:

- **Part A** a taxonomy table, a leading/lagging classification, the conversion-rate calculation, one KPI definition sheet, and a maturity judgement;
- **Part B** ROI, NPV (with working), the recurring-income comparison, the employment-impact estimate, the licensing-distribution comment, and one sustainability measure;
- **Part C** a completed six-row dashboard scorecard, a one-page executive brief, a 150–200 word impact narrative, and one forward recommendation.

A full submission is roughly 6–10 pages including tables. The marking rubric at the end shows how each part is weighted.

How the parts map to the course

Part	Lesson	You will produce
A Conceptualize	Lesson 1	A KPI set, classified and defined, plus a maturity judgement
B Value	Lesson 2	ROI/NPV, economic impact, licensing and sustainability analysis

C Report	Lesson 3	A dashboard sketch, an executive brief and an impact narrative
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The case: Tetova Regional Innovation Hub

The Tetova Regional Innovation Hub (TRIH) is the technology transfer office of a mid-sized regional university in the Western Balkans. It opened five years ago. Its mission is to translate the university's research into regional economic and social value. Leadership has asked for an evidence-based evaluation: is the hub working, what is it worth, and what should the board be told?

All tables below are the data you have. Year 5 is the most recent completed year.

Table 1 Inputs and context

Item	Value
University research expenditure (Year 5)	€8.0 million / year
TTO staff	4.0 FTE
Academic staff (FTE)	320
Hub age	5 years (Year 1 = first year of operation)
Published regional employment multiplier	1.8 (use this value)
Discount rate for appraisal	8% per year

Table 2 Activity and outputs by year

Indicator	Y1	Y2	Y3	Y4	Y5
Invention disclosures	8	12	18	22	26
Patents filed	2	4	5	6	7
Licences & options executed	0	1	2	3	4
Spin-offs created	0	1	1	2	2
Collaborative/contract agreements	5	9	12	15	18

Cumulative spin-offs created over the five years: 6. Of these, 5 are still operating at the end of Year 5.

Table 3 Income and cost by year (€000s)

Stream	Y1	Y2	Y3	Y4	Y5
Licence income	0	10	35	70	110
Contract research income	40	70	95	120	150
Service income	10	15	20	25	30
Spin-off equity realized (one-off exit)	0	0	0	0	260
Operating cost	220	235	245	255	265

Table 4 Year 5 licence income, by deal (€000s)

Deal	A	B	C	D
Licence income	70	22	10	8

Year 5 employment: the hub's spin-offs and licensees directly employ 14 people.

Part A Conceptualize the metrics (Lesson 1)

Establish what to measure and how to judge the hub's stage of development.

Tasks

1. From Tables 2–3, place each indicator on the inputs–activities–outputs–outcomes–impact taxonomy. Present your answer as a short table.
2. Classify five indicators of your choice as leading or lagging, and as quantitative or qualitative. Justify each in one line.
3. Calculate the pipeline conversion rate (licenses executed ÷ disclosures) for Year 5, and comment on what it does and does not tell you.
4. Write one complete KPI definition sheet (use the template in the Appendix) for a single KPI you would put on the hub's scorecard.
5. Using the maturity model, state which stage TRIH is at and give two reasons. Name the one indicator category you would foreground when reporting a hub at this stage.

Deliverable A

- A taxonomy table, a leading/lagging classification, the conversion-rate calculation with comment, one KPI definition sheet, and a one-paragraph maturity judgement.

Part B Value the outcomes (Lesson 2)

Now establish what the hub's activity is worth. Show your working for every calculation.

Tasks

1. Compute the hub's simple five-year ROI on operating cost, using total income (all streams) against total operating cost. State the percentage.
2. Compute the net present value (NPV) of the five years of net cash flow (income minus cost) at the 8% discount rate. Is it positive? Show the discounted figures by year.
3. Strip out the one-off spin-off equity exit. Recompute recurring net income for Year 5 and comment on what the difference means for how sustainable the hub is.
4. Estimate the total employment impact of the hub in Year 5 using the regional multiplier of 1.8, starting from the 14 direct jobs. Show direct, indirect-plus-induced, and total.
5. Using Table 4, describe the distribution of Year 5 license income. What share comes from the single largest deal, and what does that imply for how the hub should set expectations?
6. Give one measure of the hub's financial sustainability and compute or estimate it from the data. Comment briefly on the trajectory across the five years.

Formula reminders

Simple ROI = (total income – total cost) ÷ total cost × 100.

$NPV = \sum [\text{net cash flow in year } n \div (1 + 0.08)^n]$ across Years 1–5. Treat Year 1 as $n = 1$.

Total employment impact = direct jobs $\times$ multiplier. Indirect-plus-induced = total – direct.

Deliverable B

- The ROI percentage, the NPV with year-by-year discounted figures, the recurring-income comparison, the employment-impact estimate, the license-distribution comment, and one sustainability measure all with working shown.

Read your results in context

Do not stop at the sign of the number. A five-year ROI or NPV can be unflattering for a hub this young while the year-by-year trend tells a very different story. Part of the task is to notice which way the trajectory points and to judge the hub against its maturity stage, not against a mature office.

Part C Report the result (Lesson 3)

Turn your analysis into something a board would act on. The audience is the university's leadership, not specialists.

Tasks

- Build a one-screen KPI scorecard for TRIH using the template below. Choose six KPIs spanning leading and lagging, set a target and an amber/red trigger for each, and enter the Year 5 actual. Use a red-amber-green status.
- Write a one-page executive brief: situation, the three or four findings that matter most, and a clear recommendation. Lead with the decision, not the data.
- Write a short impact narrative (150–200 words) that a non-specialist board member would understand, honestly reflecting the licensing skew and the one-off nature of the equity exit.
- State one thing the hub should measure or do differently next year, justified by your analysis.

Scorecard template

KPI	Type (lead/lag)	Target	Amber trigger / Red	Y5 actual	Status

Deliverable C

- A completed six-row scorecard, a one-page executive brief, a 150–200 word impact narrative, and one forward recommendation.

Marking rubric

The assignment is marked out of 100. Working must be shown; a correct number without method earns partial credit only.

Criterion	What strong work shows	Marks
Part A metric design	Correct taxonomy and classification; sound conversion calc; a complete, usable KPI sheet; defensible maturity judgement	25
Part B valuation	Correct ROI and NPV with working; recognizes that an unflattering multi-year figure can coexist with a healthy trajectory; recurring-vs-one-off insight; correct multiplier use; reads the licensing skew correctly	30
Part C reporting	Actionable scorecard with sensible targets/triggers; decision-led brief; honest, clear narrative; justified recommendation	30
Integration & judgement	The three parts cohere; analysis fits the hub's maturity; assumptions stated; no over claiming	10
Presentation	Clear tables and prose; correct units; within length	5

Submission

Submit one PDF or Word file via the Moodle assignment activity for this course. Name the file **Surname_TRIH_Capstone**. The capstone unlocks after the Lesson 3 quiz is passed, and must be submitted to complete the course and release the certificate.

Appendix KPI definition sheet template

Complete one sheet per KPI in Part A, Task 4. This is the same template used in Lesson 1's toolkit.

Field	Your entry
KPI name	
Definition & formula	
Taxonomy category (input → impact)	
Leading or lagging	
Source system	
Counting rule	
Data owner	
Quality check (validity / reliability)	
Gaming risk & balancing metric	

A note on honesty in the capstone

The strongest submissions are not those that make the hub look best. They are the ones that read the data accurately acknowledging that one equity exit flatters Year 5, that license income is skewed toward a single deal, and that an emerging hub should be judged on trajectory. Honest evaluation is the whole point of the course.

Chapter III: Startup Creation through TT Hubs: From Research Idea to Market

Course overview

This course introduces the intellectual-property concepts and innovation-ecosystem structures that underpin technology transfer. It connects IP protection with university research, commercialization, entrepreneurship and responsible innovation.

Course learning outcomes

- Define intellectual property and explain its role in innovation and commercialization.
- Distinguish patents, copyright, trademarks, trade secrets and know-how.
- Explain innovation ecosystems and the roles of universities, industry, investors, government, TTOs and support organizations.
- Recognize patentability, prior art and freedom-to-operate considerations.
- Explain how Technology Transfer Offices support invention identification, protection and commercialization.
- Identify ethical, sustainability and emerging AI-related issues in innovation.

Recommended LMS learning flow

- Study the lesson content in the LMS.
- Complete reflection questions and knowledge checks.
- Apply concepts to a real or hypothetical university technology.
- Take the quizzes
- Complete the practical assignment before progressing to the next course.

Lesson 1: Ideation and Problem-Solution Alignment

Lesson overview. The lesson establishes the conceptual foundation for IP and innovation ecosystems. It explains why intellectual property matters, introduces major IP rights, describes ecosystem actors and connects research discoveries to commercialization.

Learning outcomes

- Define intellectual property and explain its strategic importance.
- Distinguish patents, copyright, trademarks and trade secrets.
- Describe innovation ecosystems and their principal actors.
- Explain patentability, prior art and the importance of managing disclosure.
- Describe the role and functions of Technology Transfer Offices.

Core topics

- Introduction to intellectual property
- Types of IP and integrated IP strategies
- Innovation ecosystems and ecosystem actors
- Patentability: novelty, inventive step and industrial applicability

- Prior art and patent information
- University IP policies and ownership
- Technology Transfer Offices and commercialization pathways
- Ethics, AI, sustainability and responsible innovation

Learning activity / reflection

Choose a research result from a university or innovation hub. Identify the IP assets involved, the relevant ecosystem actors and the key risks before public disclosure.

Lesson summary

IP protection is a strategic component of innovation rather than an isolated legal exercise. Effective technology transfer combines appropriate protection, ecosystem relationships and a clear route from research to practical application.

1. Lesson 1 - Course Material

Ideation, Problem-Solution Alignment, and Business Model Engineering for Deep Tech Startups

ABSTRACT: This course merges ideation, customer discovery, lean experimentation, business model engineering, EU technology transfer pathways, and practical lessons from SEEU experience into one applied training unit. The emphasis is not only on creating a startup, but on deciding whether a research result should become a license, a spin-off, a collaborative R&D project, or a service delivered through a technology transfer hub.

2. Introduction and Learning Outcomes

This course material is designed as a practical bridge between university research, technology transfer, and startup creation. Many research-based innovations fail not because the science is weak, but because the team does not validate demand, identify the economic buyer, select the correct commercialization pathway, or build a sustainable operating model. The lesson therefore begins with problem-solution alignment and ends with business model engineering, funding strategy, and technology transfer hub support mechanisms.

The starting assumption is that research commercialization is not a linear route from laboratory discovery to market launch. In practice, the process is iterative, political, institutional, and market-dependent. A research team may discover that its first application is not the strongest one. A technology transfer hub may learn that a licensing pathway is more realistic than a spin-off. A university may learn that a promising platform has no long-term owner. A founder may learn that grants provide development time, but do not prove that customers will pay. These realities are central to the lesson:

1. Research commercialization should be treated as disciplined learning under uncertainty.
2. A startup is not a smaller version of a company.
3. A university innovation is not automatically a market opportunity.
4. A technology transfer hub must help teams test assumptions before committing scarce time, funding, and institutional credibility.

By the end of this lesson, participants should be able to:

- Distinguish between market-pull and technology-push innovation and identify the failure points of science-centric startups.
- Translate a research result into a problem hypothesis, customer hypothesis, value proposition hypothesis, and adoption hypothesis.
- Apply the Build-Measure-Learn logic in research environments with long R&D cycles, regulatory constraints, and high technical uncertainty.
- Design and conduct problem interviews that avoid premature technology disclosure and reduce confirmation bias.
- Use a deep-tech adaptation of the Business Model Canvas to describe customers, beneficiaries, payers, partners, intellectual assets, and revenue mechanisms.
- Evaluate whether a technology should be licensed, spun off, piloted through collaborative R&D, or developed as a TTH-supported service.
- Assess strategic moats, including intellectual property, know-how, data access, regulatory positioning, networks, and switching costs.
- Map an innovation to TRL stages, funding instruments, and support networks, especially in the EU and Western Balkans context.
- Use SEEU technology transfer cases to diagnose sustainability gaps, institutional readiness problems, and scaling barriers.

Table 1 Suggested duration and learning flow for self-learners

Segment	Time	Learning focus	Output
Opening and ecosystem framing	20 min	Why research innovations fail and how TTHs reduce risk	Shared understanding of commercialization routes
Market pull vs. technology push	35 min	Problem-solution alignment and failure points	Initial problem statement
Lean startup in research	40 min	Build-Measure-Learn for high-complexity technical environments	Assumption map and experiment plan
Customer discovery	60 min	100 interviews, early adopters, and bias reduction	Interview script and stakeholder map
Problem interview simulation	45 min	Practical interview role-play	Validated pain point notes
Business model engineering	60 min	Deep-tech BMC adaptation and revenue logic	Draft business model canvas
Moats, IP, dual-use, and funding	50 min	Defensibility, TRL, funding ladder, and TTH sustainability	Commercialization pathway decision
Quiz and reflection	30 min	Learning assessment	Individual quiz and group debrief

3. From Research Result to Market Opportunity

A research result becomes valuable when it can be translated into a repeatable solution for a defined problem in a defined context. The transition from research to opportunity is not automatic.

A paper, prototype, patent, algorithm, dataset, design, or laboratory process may have scientific value without yet having market value. The first task of the innovator is to separate technical achievement from commercial relevance.

In a university context, the temptation is often to start with the technology: a new algorithm, a laboratory process, a software platform, a sensor, a medical insight, or a sustainability method. This is understandable because the research team has invested years in developing the technology. However, the market does not buy scientific novelty. It buys reduced risk, lower cost, improved performance, compliance, speed, access, reputation, or another measurable benefit. The practical question is therefore not, "What have we invented?" but "Who has a problem serious enough to change behavior, pay, procure, license, adopt, or co-invest?"

Technology transfer hubs are important because they help research teams move from invention logic to adoption logic. They support IP scouting, proof-of-concept planning, freedom-to-operate analysis, licensing, spin-off incubation, training, and industry engagement. In the attached TTH funding material, the operating model includes IP scouting and evaluation, FTO studies, proof-of-concept funding and piloting, commercialization and licensing, spin-off incubation, governance, and capacity building. These functions are not administrative details. They are the practical mechanisms that transform research from isolated outputs into structured innovation pipelines.

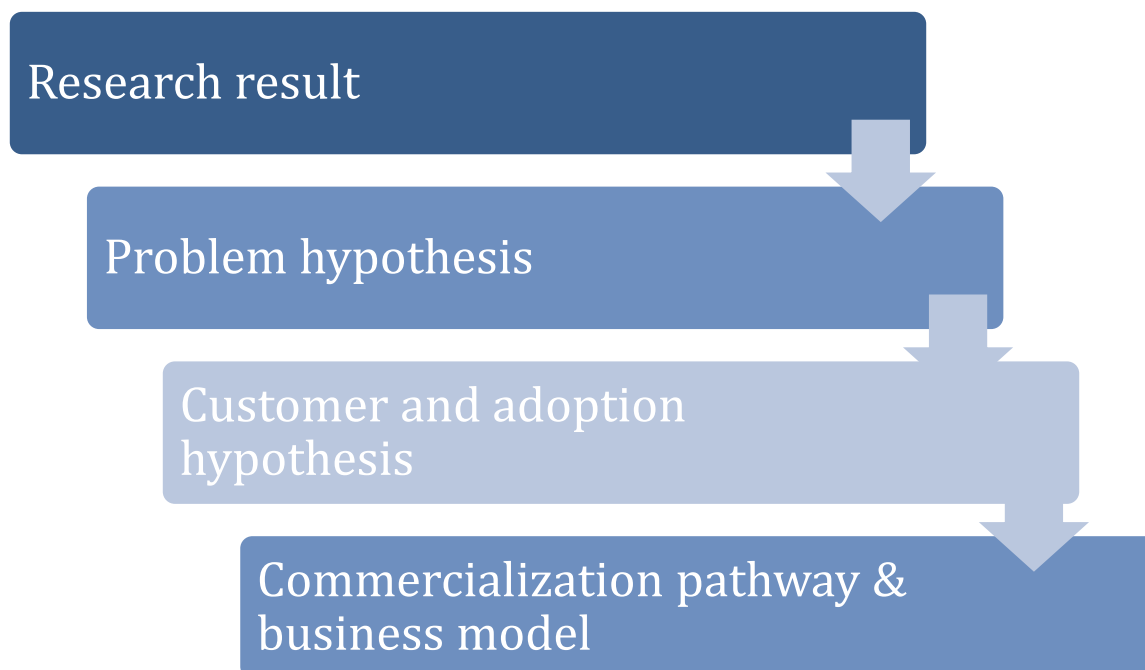


Figure 1- **The opportunity translation sequence**

In the figure above (Figure 1) the steps needed to translate the opportunity from research to business are shown in sequence. Further they are explained in the Table below.

Table 2 - The opportunity translation sequence

Step	Question	Typical evidence	Risk if skipped
Research result	What exactly exists today?	Publication, prototype, dataset, patent draft,	The team overstates maturity and underestimates

		laboratory result, software demo	missing engineering work
Problem hypothesis	What painful problem could this solve?	Problem statements from users, public data, stakeholder complaints, regulatory pressure	The solution addresses a technically interesting but low-priority issue
Customer and payer hypothesis	Who uses it and who pays for it?	Stakeholder map, buyer roles, procurement path, budget holder interviews	The user likes it but no actor has budget or authority to buy
Adoption hypothesis	What would make the user switch?	Current workflow analysis, switching cost, integration needs, training needs	The solution is better but adoption friction is too high
Commercialization pathway	Should this be licensed, spun off, piloted, or embedded in a hub service?	TRL, team capacity, IP position, market size, partner interest	The team chooses a startup path when a license or collaborative project is more realistic
Business model	How does value become revenue or sustainable funding?	BMC, pricing, unit economics, grants, service fees, equity, royalties	The project ends when the grant ends

Exercise on your own:

Name one research result you know well.

Describe it without using technical features (include the affected stakeholder, the pain, the current workaround, and the consequence of not solving the problem)

4. Technology Transfer Ecosystem and Pathways to Market

Technology transfer happens inside an ecosystem. A university alone rarely has all the resources needed to commercialize research. The ecosystem usually includes knowledge producers, intermediaries, funding bodies, market actors, support networks, and IP support institutions. The EU technology transfer material used for this lesson frames these actors as universities and research institutes, TTOs, TTHs, EDIHs, the European Commission, EIC and national funds, SMEs and corporates, EEN and EIT communities, and IP institutions such as EPO and WIPO. The training implication is clear: innovation teams must learn not only how to build a technology, but also where to go for each missing resource.

A technology transfer hub should act as an orchestrator. It identifies internal research outputs, connects them with industry and public sector needs, supports IP and market validation, matches teams with funding instruments, and helps select the correct commercialization pathway (see Figure 2). This is particularly important in the Western Balkans, where innovation capacity exists but ecosystem fragmentation, limited private risk capital, and institutional inertia can delay commercialization.

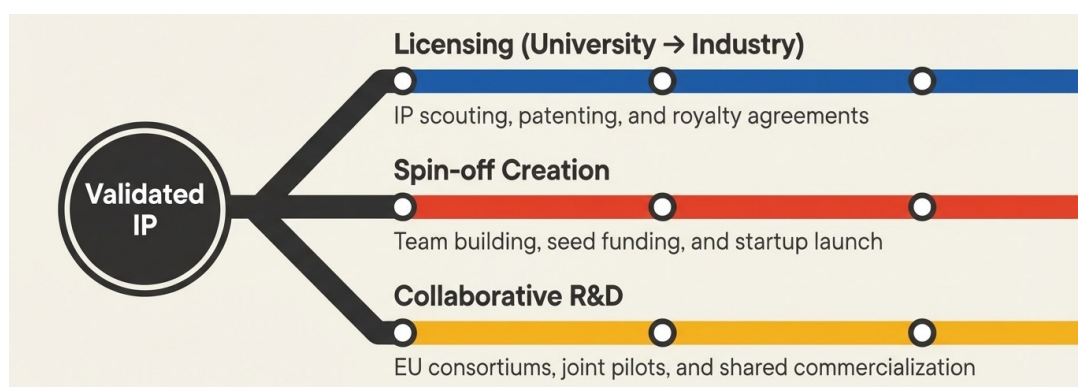


Figure 2 - Pathways to market

Pathway 1: Licensing

Licensing is appropriate when the university or inventor does not want to build a company, when an existing company already has market access, or when the technology is a component that can be embedded into a larger product. The process usually includes IP identification, patent filing or other protection, industry partner search, and licensing agreement. Licensing can generate royalties, upfront payments, milestone payments, or strategic partnerships. It is not passive. The team still needs evidence that the technology solves a relevant industrial problem and that a partner has the capacity to integrate it.

Pathway 2: Spin-off creation

A spin-off is more suitable when the technology requires a dedicated team, new product development, market education, and scalable business execution. The process includes proof-of-concept validation, team formation, business model design, seed funding, and progressive market entry. University spin-offs are demanding because they require researchers to operate in an environment with different incentives, speed, risk tolerance, and decision-making logic. A spin-off is not simply a legal company created around a patent. It is a learning organization that must validate a business model while advancing the technology.

Pathway 3: Collaborative R&D and pilots

Collaborative R&D is appropriate when the technology is not yet market-ready, when several partners are needed to validate the solution, or when the market problem requires cross-border and multidisciplinary capacity. Horizon Europe, EIC Transition, EDIH networks, Interreg, IPA, EEN partnerships, and corporate proof-of-concept projects can support this pathway. Collaborative R&D can help teams cross the TRL 4-6 valley, but it can also create a false sense of progress if pilots are not linked to ownership, procurement, adoption, and post-project sustainability.

A list of some pathways can be found in the table below (Table 3), with the roles of TTH also elaborated. In addition to the table, a PATHWAY MATRIX cheat sheet (Figure 3) should help you to understand what and where.

Table 3 - Pathways to market

Pathway	Best when	Main risk	TTH support needed
Licensing	Existing market actors can commercialize faster than a new startup	Weak partner interest or unclear IP position	IP scouting, FTO, partner search, negotiation support

Spin-off	The opportunity requires a dedicated company and scalable execution	Founder team lacks business capacity or customer access	Incubation, team building, BMC coaching, investor readiness
Collaborative R&D	Technology needs validation in relevant environments and multiple partners	Pilot ends without adoption or ownership	Consortium building, TRL roadmap, exploitation plan, sustainability model

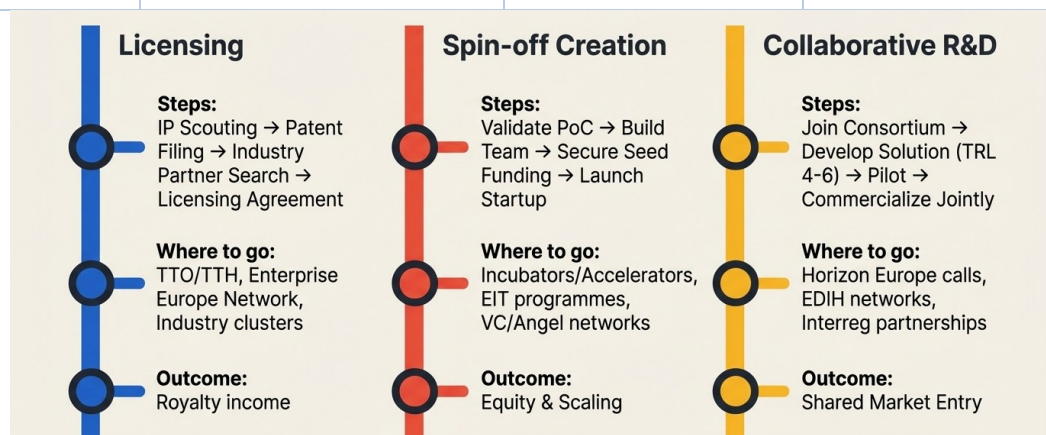


Figure 3 - PATHWAY MATRIX CHEAT-SHEET

5. Market Pull versus Technology Push

Market pull begins with a **validated need**. Technology push begins with **an existing invention** and then searches for applications. Both can produce innovation, but technology push is more dangerous when the team treats the invention as proof that a market exists. Science-centric startups often fail (see Table 4) because they confuse novelty with demand, technical feasibility with adoption readiness, and grant success with customer validation.

The central critique of technology-push startups is not that scientists should stop inventing. It is that the market discovery process must be explicit and evidence-based. A technical founder may believe that the best application is obvious because the performance gain is obvious in laboratory terms. Yet users evaluate solutions through workflows, procurement rules, risk, trust, integration, habits, regulation, and budget cycles. A superior technology may be ignored if it requires a hospital, municipality, university, manufacturer, or ministry to change too much too quickly.

Table 4 - Common failure points of science-centric startups

Failure point	What it looks like	Why it happens	Corrective action
Problem invented after the solution	The team writes a problem statement that mainly describes the technology features	Attachment to research output and pressure to commercialize	Conduct problem interviews before presenting the solution
No economic buyer	Users are interested, but no one has a budget or procurement authority	User and payer are assumed to be the same	Map user, buyer, beneficiary, regulator, and influencer roles
Pilot addiction	The team completes pilots but no customer converts to contract or adoption	Pilots are treated as success instead of tests	Define conversion criteria before the pilot starts

Grant dependency	Development continues only when new project funding is available	Funding is confused with market validation	Build earned income, licensing, investment, or procurement pathway
No adoption owner	The platform works but no institution maintains or scales it	Ownership is assumed, not negotiated	Secure owner, budget, governance, and maintenance plan
Ecosystem unreadiness	Technology is ready, but regulation, data access, standards, or users are not	TRL is measured technically only	Assess institutional, regulatory, and market readiness alongside TRL

Problem-solution alignment logic

Problem-solution alignment is reached when a clearly defined customer segment acknowledges a painful problem, currently spends time or money dealing with it, recognizes the proposed solution as relevant, and shows willingness to continue engagement through data sharing, pilot participation, procurement, licensing, investment, or other concrete commitment. In early stages, the goal is not to prove that the technology is excellent. The goal is to discover whether the problem is urgent enough to justify further commercialization work. See Table 5 for template on how to define problem-solution logic.

Practical rule: Do not start with a product demo. Start with a problem conversation. A demo often triggers politeness, curiosity, or technical feedback. A problem interview reveals whether the pain is real, frequent, expensive, and owned by someone with decision power.

Table 5 - Problem statement template

Field	Prompt	Example
Stakeholder	Who experiences the problem?	Emergency response coordinators in medium-sized municipalities
Context	When and where does the problem appear?	During floods, fires, storms, or multi-agency crisis exercises
Pain	What is difficult, slow, risky, or costly?	They lack real-time situational awareness and simulation-based training
Current workaround	How do they solve it today?	Manual reports, fragmented radio communication, static plans, and occasional drills
Consequence	What happens if the problem is not solved?	Delayed decisions, poor coordination, higher operational risk, and reputational damage

Evidence needed	What would prove the problem is real?	Interview frequency, incident reports, training budgets, procurement plans, pilot requests
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6. Lean Startup Methodology for Research and Deep Tech

Lean Startup methodology is useful for research commercialization because it changes the mindset from planning under certainty to learning under uncertainty. The Build-Measure-Learn loop (Table 6) emphasizes rapid experiments, actionable metrics, and validated learning. For deep tech, this logic must be adapted because prototypes can be expensive, regulatory constraints can slow testing, and scientific uncertainty may remain high. The goal is not to force every research team to move like a software startup, but rather to design the smallest credible experiment that can reduce the biggest uncertainty.

In scientific and engineering environments, the Build phase may not always mean building a full prototype. It may mean preparing a simulation, data mock-up, clickable workflow, laboratory demonstration, regulatory briefing, service blueprint, technical feasibility memo, or controlled pilot protocol. The Measure phase should focus on evidence that changes decisions. The Learn phase should produce a decision: persevere, pivot the use case, change the customer segment, seek a licensee, redesign the pilot, stop the project, or move to a different pathway.

Table 6 - Adapting Build-Measure-Learn to research settings

Lean step	Standard startup meaning	Research/deep-tech adaptation	Example evidence
Build	Create an MVP to test assumptions	Create the smallest credible artifact that allows stakeholders to react meaningfully	Simulation, lab demo, Figma mock-up, dataset sample, pilot protocol, service blueprint
Measure	Collect actionable metrics from users	Collect decision-quality evidence from customers, regulators, partners, and technical experts	Commitment to pilot, budget signal, data access letter, integration requirement, FTO concern
Learn	Decide whether to pivot or persevere	Update technical, market, regulatory, IP, and commercialization assumptions	Change target sector, narrow use case, license instead of spin off, apply for EIC Transition

Assumption hierarchy for deep tech

Deep-tech ventures should not test all assumptions equally. They should prioritize assumptions that are both uncertain and fatal. A fatal assumption is one that can kill the project if wrong. Examples include: hospitals will share data, municipalities will procure the system, manufacturers will integrate a new sensor into production lines, a patent can protect the core method, or the prototype can move from lab conditions to real-world conditions. Well, these assumptions can be risky, therefore use Table 7 to address these assumptions before moving forward.

Table 7 - Assumption hierarchy for deep tech

Assumption type	Core question	Evidence target	Experiment
Problem	Is the problem frequent, painful, and costly?	At least 60-70 percent of target interviewees describe the same pain without prompting	Problem interviews
Customer	Who has the strongest pain? Can he pay/buy?	Clear early adopter profile and repeated signals from a narrow segment	Segmented interviews and ranking
Technical	Can the solution work in relevant conditions?	Performance evidence outside the lab or credible path to TRL increase	Prototype, simulation, pilot
Regulatory / IP	What permissions, standards, or compliance rules apply? Can the team protect or use the technology?	Known requirements and no obvious blocking condition. IP strategy.	Regulatory expert review. IP audit.
Business model	Can value be captured sustainably?	Willingness to pay, license, co-fund, or adopt	Pricing conversations and pilot conversion criteria

Deep-tech MVP principle: The minimum viable product is not the cheapest artifact. It is the minimum credible artifact. In regulated, scientific, or enterprise environments, an artifact must be credible enough to generate serious stakeholder feedback.

7. Advanced Customer Discovery and the 100 Interview Rule

Customer discovery is the disciplined process of validating assumptions about customers, users, problems, workflows, buying behavior, and adoption barriers. The 100 Interview Rule, widely associated with evidence-based entrepreneurship and I-Corps style training, is not a magic number. Its purpose is to force founders out of internal discussion and into repeated contact with the market. For research teams, the rule is especially valuable because it reduces the risk of building for imagined users.

In deep tech, 100 interviews should not be interpreted as 100 identical conversations. A useful discovery process includes several stakeholder categories: end users, buyers, technical integrators, regulators, procurement officers, investors, industry experts, potential licensees, competitors, and ecosystem intermediaries (Table 8). The first 20 interviews may reveal that the original customer segment is wrong. The next 30 may reveal a narrower early adopter profile. Later interviews may clarify buying criteria, budget cycles, adoption objections, and partnership opportunities.

Table 8 - Interview types across the discovery journey

Interview type	Main purpose	Who to interview	What not to do
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Problem interview	Understand pain, context, workflows, current alternatives	Users and operational staff	Do not pitch the technology
Buyer interview	Understand budget, procurement, ROI, decision process	Managers, procurement officers, budget holders	Do not assume interest equals payment
Expert interview	Understand regulation, standards, competitive landscape, technical feasibility	Domain experts, legal/IP experts, standards experts	Do not outsource the commercial decision to experts
Partner interview	Understand integration, channels, pilot access, distribution	SMEs, corporates, hubs, clusters, EDIHs, NGOs	Do not treat every partner as a customer
Investor interview	Understand investability, risk perception, milestones	Angels, VCs, impact investors, corporate venture units	Do not replace customer evidence with investor enthusiasm

A practical structure for 100 interviews is shown below (see Table 9). The numbers can be adjusted, but the logic should remain: start wide enough to avoid premature narrowing, then become increasingly focused on the most promising early adopter segment.

Table 9 - The 100 Interview Rule in practice

Interview block	Number	Purpose	Expected output
Exploratory problem interviews	20	Identify recurring pains and current workarounds across possible segments	Longlist of problem patterns
Segment comparison interviews	20	Compare which segment has the strongest pain and highest urgency	Early adopter profile
Buyer and procurement interviews	15	Clarify who pays, how decisions are made, and which budgets apply	Economic buyer map
Technical and integration interviews	15	Understand implementation barriers, standards, data needs, and interoperability	Adoption barrier list
Partner and channel interviews	10	Identify routes to market and support organizations	Partner/channel options
Regulatory and IP interviews	10	Assess compliance, FTO, and protection issues	Risk register
Pricing and commitment interviews	10	Test willingness to pay, pilot terms, and continuation criteria	Commercialization decision evidence

Interview script for problem discovery (adjust it accordingly)

1. Start with context: "Can you describe your role and how you currently handle this process?"
2. Explore frequency: "How often does this problem occur?"

3. Explore intensity: "What happens when it goes wrong?"
4. Explore current behavior: "How do you solve it today? What tools, people, or workarounds do you use?"
5. Explore cost: "What does this problem cost in time, money, risk, compliance, reputation, or missed opportunity?"
6. Explore ownership: "Who is responsible for solving this problem in your organization?"
7. Explore buying process: "If a better solution existed, how would your organization evaluate or adopt it?"
8. Close with referral: "Who else should we speak with to understand this problem better?"

Interview discipline:

The interviewer should not ask: "Would you use our AI platform?"

A better question is: "Tell me about the last time this decision had to be made under time pressure. What information was missing? What did that cost?"

8. Business Model Engineering for Deep Tech

Business model engineering is the deliberate design of how a research-based innovation creates, delivers, and captures value. The standard Business Model Canvas (Figure 4 - Business Model Canvas) is a powerful starting point because it forces teams to connect customer segments, value proposition, channels, relationships, revenue streams, key resources, key activities, key partners, and cost structure. However, deep-tech ventures require additional attention to TRL progression, IP, regulation, validation environments, long sales cycles, and non-commercial beneficiaries.

The Business Model Canvas		Designed for:	Designed by:	Date:	Version:
Key Partners Who are our key partners? Who are our key suppliers? Which key resources are we acquiring from partners? Which key activities do partners perform? Relationships and Networks Distribution and support Acquisition and integration Acquisition of particular resources and activities	Key Activities What key activities do our Value Propositions require? Our Distribution Channels? Customer Relationships? Revenue streams? Resources Personnel Intellectual Property Platform/Networks	Value Propositions What value do we deliver to the customer? Which one of our customer's problems are we helping to solve? What bundles of products and services are we offering to each Customer Segment? Which customer needs are we satisfying? Activities Production Distribution Logistics Fulfillment Customer Support Platform/Networks Intellectual Property Personnel Financial Physical Intellectual Property Platform/Networks Distribution	Customer Relationships What type of relationship does each of our Customer Segments expect us to establish and maintain with them? Which ones have we established? How are they integrated with the rest of our business model? How costly are they? Channels Through which Channels do our Customer Segments want to be reached? How are we reaching them now? How do our Channels integrate? Which ones work best? Which ones are most cost-efficient? How are we integrating them with customer outreach? Customer Segments For whom are we creating value? Who are our most important customers? Key Resources Personnel Intellectual Property Platform/Networks Distribution Logistics Fulfillment Customer Support Platform/Networks Intellectual Property Personnel Financial Physical Intellectual Property Platform/Networks Distribution	Cost Structure What are the most important costs inherent in our business model? Which Key Resources are most expensive? Which Key Activities are most expensive? Revenue Streams For what value are our customers really willing to pay? For what do they currently pay? How are they currently paying? How would they prefer to pay? How much does each Revenue Stream contribute to overall revenues? Channels Through which Channels do our Customer Segments want to be reached? How are we reaching them now? How do our Channels integrate? Which ones work best? Which ones are most cost-efficient? How are we integrating them with customer outreach? Customer Segments For whom are we creating value? Who are our most important customers? Key Resources Personnel Intellectual Property Platform/Networks Distribution Logistics Fulfillment Customer Support Platform/Networks Intellectual Property Personnel Financial Physical Intellectual Property Platform/Networks Distribution	

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Figure 4 - Business Model Canvas

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A deep-tech business model often has multiple value actors. The end user may not be the payer. The beneficiary may be society, while the buyer is a ministry, hospital, municipality, school, manufacturer, or corporate partner. The regulator may strongly influence adoption. The university may hold IP or equity. The TTH may provide incubation, testing facilities, training, and partner access. For this reason, the canvas should be treated as a hypothesis map, not a business plan.

Table 10 - Deep-tech Business Model Canvas adaptation

Canvas block	Deep-tech adaptation question	Evidence needed
Customer segments	Who experiences the problem, who pays, who approves, and who blocks adoption?	Stakeholder map and buyer interviews
Value proposition	What measurable improvement is created compared with current alternatives?	Pain evidence, performance evidence, economic or social benefit
Channels	How will the solution reach customers in a sector with trust, procurement, or regulatory barriers?	Partner/channel interviews, procurement route, EEN/cluster/EDIH options
Customer relationships	What support, training, onboarding, and trust-building are required?	Adoption journey and support model
Revenue streams	Will revenue come from licenses, subscriptions, service fees, consulting, pilots, grants, royalties, equity, or public procurement?	Pricing tests, willingness to pay, grant and investment roadmap
Key resources	Which IP, data, facilities, certifications, team skills, and institutional assets are critical?	IP audit, data agreements, laboratory/testbed access, team map
Key activities	What must be done to increase TRL, market readiness, and adoption readiness?	TRL roadmap, pilots, regulatory plan, sales process
Key partners	Which partners reduce adoption risk or provide missing capabilities?	Letters of interest, pilot partners, universities, SMEs, corporates, EDIHs, EIT/EEN
Cost structure	What are the real costs of R&D, validation, compliance, support, sales, and scaling?	Budget, unit economics, runway, TTH service cost, funding mix

Deep-tech value proposition formula

A strong value proposition should identify the customer, the painful job, the current alternative, the measurable improvement, and the reason the solution is credible. A practical formula is: For [specific stakeholder] who must [critical job] under [constraint], our solution helps them

[measurable outcome] compared with [current alternative], because [technical or ecosystem advantage].

Example: For municipal emergency coordinators who must coordinate multi-agency response during floods under time pressure and incomplete information, an AI-supported crisis training and decision platform helps reduce coordination delays and improve preparedness compared with manual drills and fragmented reports, because it combines simulation, scenario-based training, and data-driven operational support.

Business model stress test

The purpose of the stress test is to expose weak assumptions before the team invests heavily in development. Each team should test its business model under at least four conditions: longer R&D cycle, lower willingness to pay, delayed regulatory approval, and dependence on one institutional champion. If the model collapses under a realistic condition, the team should redesign the model or choose another commercialization pathway.

Stress condition	Question	Possible response
R&D takes twice as long	Can the team survive technically and financially?	Seek EIC Transition, corporate PoC, staged milestones, or licensing partner
Users love it but buyers do not pay	Is there another payer or procurement route?	Re-map economic buyer, use public procurement, CSR, grant-supported service, or B2B partner
Regulation delays adoption	Can value be created in a lower-risk use case first?	Start with training, simulation, analytics, or non-clinical/non-operational environment
A pilot partner withdraws	Is the pipeline diversified?	Recruit multiple pilot sites and create standardized onboarding
IP cannot be protected strongly	What alternative moat exists?	Use data access, speed, know-how, brand, network, integration, or service model
Grant funding ends	Who pays next?	Define service fees, licensing, maintenance contracts, equity, overhead, or membership model

9. Funding, TRL Progression, and TTH Sustainability

Technology Readiness Levels (Figure 5 - Technology Readiness Levels) provide a common language for describing technology maturity from early research to commercial deployment. In EU innovation practice, TRL thinking helps teams match maturity with appropriate funding instruments and support mechanisms. Early-stage breakthrough research may fit EIC Pathfinder or Horizon Europe research calls. Proof-of-concept and business maturation may fit EIC Transition or national innovation grants. Market deployment and scale-up may fit EIC Accelerator, Digital Europe deployment actions, corporate investment, VC, or public procurement.

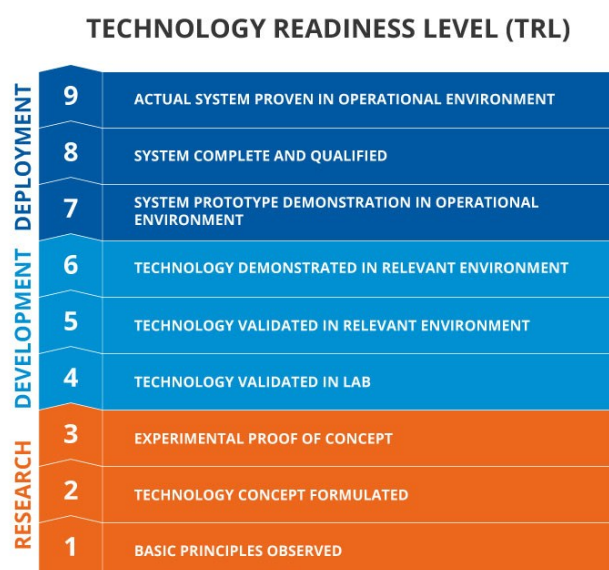


Figure 5 - Technology Readiness Levels

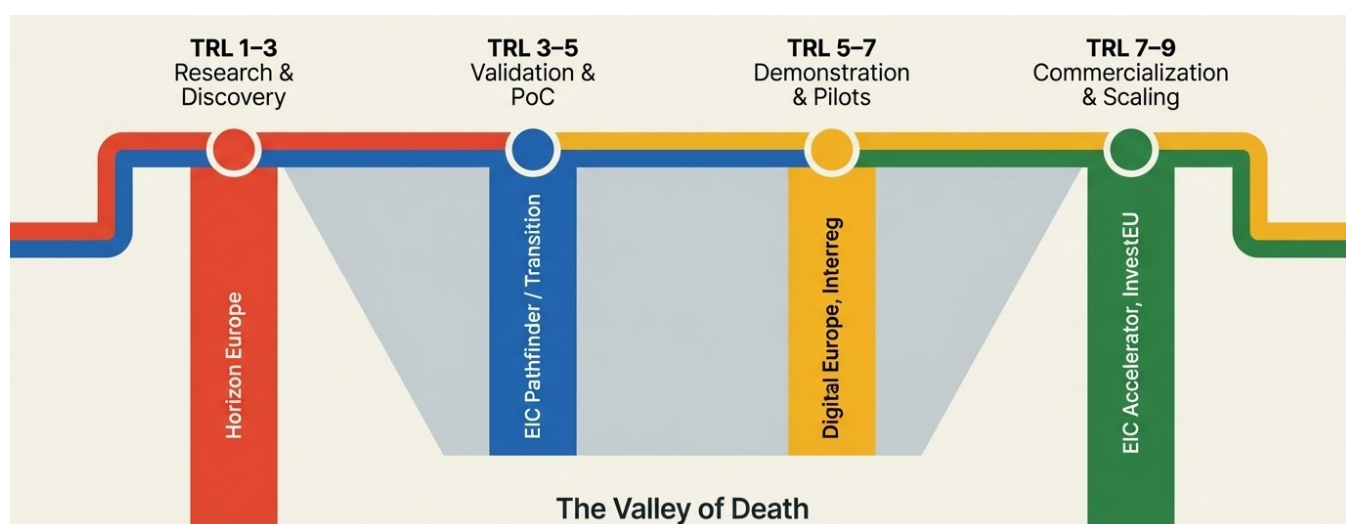


Figure 6 - The Valley of Death for research to market

The above visualized figure (Figure 6 - The Valley of Death for research to market) emphasize the TRL 4-6 valley of death, where research funding may end while private investment is not yet ready. This is one of the most important gaps for technology transfer hubs to address. At TRL 4-6, the technology may be validated in a lab or relevant environment, but not yet proven enough for customer adoption or investor confidence. Teams need bridge funding, pilot access, regulatory navigation, market validation, and business model evidence.

Table 11 - TRL ranges and stage of research

TRL range	Typical stage	Commercial question	Possible support
TRL 1-3	Research and concept formulation	Could this become useful for a real problem?	Research grants, EIC Pathfinder, IP scouting, early problem interviews

TRL 3-5	Proof of concept and validation	Which use case and customer segment should be prioritized?	PoC funding, TTH support, customer discovery, FTO, EIC Transition preparation
TRL 5-7	Demonstration in relevant environments	Will customers adopt, pay, procure, or co-invest?	Pilots, EDIH services, Digital Europe, Interreg/IPA, corporate PoCs
TRL 7-9	Market entry and scaling	Can this scale as a company, license, or sustainable service?	EIC Accelerator, VC, procurement, licensing, commercial partnerships

Funding strategy map for research-based startups is well elaborated in the figure bellow. based on the research team's needs and or SMEs needs, there are several addresses within the EU project ecosystem that can help and be supportive. Use this EU Support map (Figure 7 - EU Support map) as a guideline that can drive your needs to the right address.

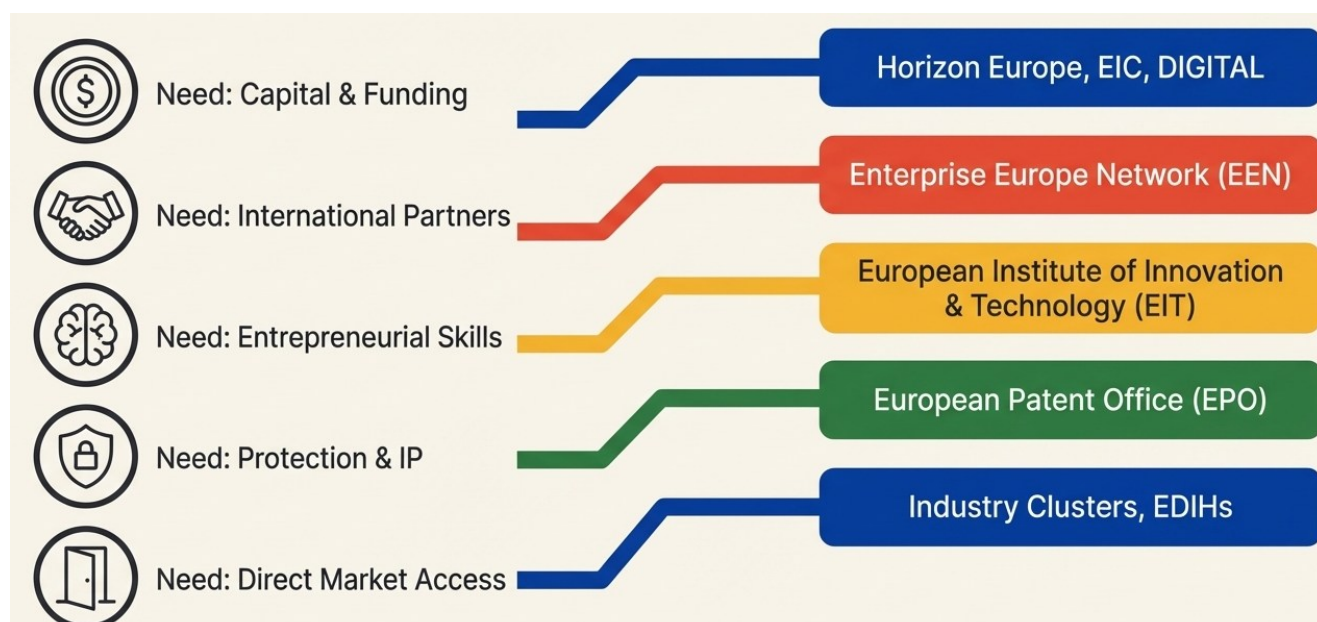


Figure 7 - EU Support map

10. Integrated Case Study: From University AI Research to Startup or Hub Service

The following case study can be used as the central classroom exercise. It combines the logic of market-pull validation, lean experimentation, business model engineering, IP and moats, TRL progression, and TTH support.

Case background

A university research group has developed an AI-assisted crisis management training platform. The system combines scenario generation, extended reality simulation, and decision-support analytics. The original research was funded through academic projects and demonstrated in controlled environments. The team believes the system could support civil protection agencies, municipalities, hospitals, schools, industrial safety departments, and security training providers. The technology is promising, but the team has not yet validated who has the strongest pain, who

pays, which use case should be prioritized, and whether the pathway should be a spin-off, license, collaborative R&D project, or TTH-supported service.

Current assumptions

Assumption	Current belief	Risk
Problem	Emergency institutions need better training and real-time decision support	Pain may be real but budgets may be limited
Customer	Municipalities and crisis management agencies are primary customers	Procurement could be slow and fragmented
Value proposition	XR and AI will improve readiness and coordination	Users may prefer simpler training formats
Technology	Prototype works in controlled demos	May require significant adaptation for real environments
Revenue	Customers will pay for licenses or training	Interest in pilots may not convert to recurring revenue
Moat	University know-how and simulation content provide advantage	Large vendors could copy features if no data or network moat exists
Pathway	Spin-off is the preferred route	Licensing or TTH service model may be more realistic initially

Case tasks

1. Write a problem statement for one target segment without mentioning AI or XR.
2. Design a 20-interview discovery plan that includes users, buyers, partners, and regulators.
3. Define the smallest credible experiment that could test demand before building the next prototype.
4. Complete a deep-tech Business Model Canvas for the most promising segment.
5. Identify three possible moats and explain which one is strongest.
6. Choose a commercialization pathway: licensing, spin-off, collaborative R&D, or TTH service. Justify the choice.
7. Map the next 12 months of funding and validation milestones.

Suggested analysis

A realistic first pathway may be a hybrid model. The team could begin with a TTH-supported training and pilot service for civil protection and institutional crisis training, while conducting customer discovery and building evidence for a later spin-off. This avoids premature company formation before demand, pricing, and procurement are clear. It also allows the university to use its credibility, facilities, and project networks to create early references. If repeated paid pilots and strong buyer signals emerge, the team can then form a spin-off with clearer use case focus, IP position, and revenue logic.

Case studies from SEEU experience, represented in cards

The SEEU cases shown as cards illustrate recurring technology transfer pitfalls.

Please go through them and be able to understand them and why they failed. They are a good example of the use of TTH and technology transfer or knowledge transfer to business.



Case Study 1: LCMS System (2005–2008)

Description & Achievements

A custom-built university learning management platform, fully integrated with SEEU's internal administrative and academic systems. It delivered tailored functionality, strong adoption among staff, and demonstrated that the institution could develop and deploy enterprise-grade software internally.

Pitfalls & Key Lesson

Despite internal success, the platform was eventually displaced by globally scalable tools such as Google Classroom and Moodle. Maintenance costs rose while external alternatives improved rapidly.

☐ **Lesson:** Even successful internal innovation can be disrupted externally. Sustainability requires monitoring the global competitive landscape, not just internal performance.



Case Study 2: VoxPolitico (2013)

Description & Achievements

VoxPolitico applied data mining techniques to parliamentary speeches, producing strong analytics and compelling visualisations of political discourse. The technical execution was sophisticated and the outputs were genuinely insightful for researchers and journalists.

Pitfalls & Key Lesson

The project lacked a viable business model. Without a clear revenue pathway, paying customers, or institutional mandate, the platform could not sustain itself beyond the initial development phase.

☐ **Lesson:** Technical success without a business model leads to failure. Innovation must be paired with a commercialisation or sustainability strategy from day one.







OPEN
PROCUREMENT
openprocurement.mk

Case Study 3: OpenProcurement.mk (2016)

Description & Achievements

An open data platform designed to increase transparency in public procurement processes in North Macedonia. It provided accessible, structured data on government contracts, supporting civil society oversight and anti-corruption efforts.

Pitfalls & Key Lesson

No government body or civil society organisation formally adopted ownership of the platform. Without an institutional champion to maintain, update, and fund it, the platform gradually became inactive.

Lesson: Without institutional ownership, sustainability fails. Open data platforms require a committed steward – not just a builder.





TIME MACHINE
APPLICATION FOR ARCHIVING OF WEB
CONTENTS FROM MACEDONIA



MEDIA FACT CHECKING SERVICE
USAID STRENGTHENING MEDIA IN MACEDONIA
PROJECT

Case Study 4: TimeMachine (2016)

Description & Achievements

TimeMachine was a media accountability tool leveraging data analytics to track and analyse media coverage over time. It offered genuine social value – enabling researchers and watchdogs to identify bias, gaps, and trends in public discourse.

Pitfalls & Key Lesson

Despite its clear social impact, the project failed to convert that value into a sustainable funding or operational model. Impact alone did not attract the institutional or commercial support needed to continue.

Lesson: Social impact does not guarantee sustainability. Impact must be translated into a fundable, scalable proposition.



Case Study 5: Intelligent Disaster Response Systems (2016–2020)

Description & Achievements

An AI-based emergency management system developed over four years, designed to support real-time decision-making during natural disasters and crises. The system demonstrated strong technical capabilities in simulation and controlled environments.

Pitfalls & Key Lesson

Deployment failed because the surrounding ecosystem – emergency services, regulatory frameworks, interoperability standards – was not ready to absorb and operationalise a high-tech AI solution at scale.

- ❑ **Lesson:** High-tech solutions fail without ecosystem readiness. Technology cannot outpace the institutions and infrastructure meant to use it.



Case Study 6: FederatedMesh (2020)

Description & Achievements

FederatedMesh explored federated learning techniques to enable collaborative analysis of medical data across institutions – without centralising sensitive patient records. A technically innovative approach addressing real privacy and data governance challenges in healthcare.

Pitfalls & Key Lesson

The project stalled at TRL 4–5, unable to bridge the gap between proof-of-concept and clinical deployment. Regulatory complexity, procurement barriers, and lack of bridge funding compounded the challenge.

- ❑ **Lesson:** TRL 4–5 is the “valley of death” for innovation. Dedicated transition funding and regulatory navigation support are essential to cross it.





Case Study 7: AI in Education (2022)

Description & Achievements

An initiative integrating AI tools into learning and research workflows at SEEU – covering personalised learning, automated assessment support, and research assistance. The project reflected growing institutional ambition to embed AI across academic operations.

Pitfalls & Key Lesson

Uneven staff digital literacy, resistance to change, and absence of a formal AI adoption strategy created significant friction. The technology was ready; the institution was not fully prepared to receive it.

- ❑ **Lesson:** Institutional readiness is as important as technology. Change management and capacity building must precede or accompany deployment.



Case Study 8: CARE.XR (2025)

Description & Achievements

CARE.XR combines Extended Reality (XR) and AI to create immersive crisis management training and response systems. It represents SEEU's most advanced and ambitious technology transfer effort – pushing the frontier of both technology and application domain.

Pitfalls & Key Lesson

Scaling beyond pilot environments and achieving broad institutional adoption has proven to be the most demanding phase. Stakeholder alignment, procurement cycles, and user onboarding all create compounding friction at scale.

- ❑ **Lesson:** Scaling and adoption are the hardest phases. A successful pilot is not a successful transfer – the final mile demands as much investment as the first.

Lessons from SEEU experience

The SEEU cases used in the above section illustrate recurring technology transfer pitfalls. LCMS showed that successful internal innovation can be displaced by global platforms if external competition and maintenance costs are underestimated. VoxPolitico showed that strong analytics and visualizations do not guarantee sustainability without a business model. OpenProcurement.mk showed that social value and transparency do not survive without institutional ownership. TimeMachine showed that impact must be translated into fundable operations. Intelligent disaster response systems showed that high-tech solutions can fail if the ecosystem is not ready. FederatedMesh showed the danger of stalling at TRL 4-5 due to regulation, procurement, and bridge funding barriers. AI in Education showed that institutional readiness and change

management matter as much as the technology. CARE.XR shows that scaling and adoption require as much investment as pilot development

Table 12 - Rethinking the SEEU cases

Case lesson	Diagnostic question for participants
LCMS: internal success can still be disrupted externally	What external alternatives could make your solution obsolete?
VoxPolitico: technical success needs business model	Who pays, and why would they continue paying?
OpenProcurement.mk: ownership matters	Which institution owns maintenance after the project?
TimeMachine: social impact is not sustainability	How does social value become a fundable model?
Disaster response systems: ecosystem readiness matters	Are users, standards, regulation, and infrastructure ready?
FederatedMesh: TRL 4-5 valley is dangerous	What bridge funding and regulatory support are needed?
AI in Education: institutional readiness matters	What training, governance, and change management are required?
CARE.XR: pilot success is not scale success	What is the plan for adoption beyond the pilot?

Before a TTH invests in a project, the team should answer:

1. Is demand validated?
2. Who owns long-term implementation?
3. Who pays?
4. Can it scale beyond the pilot?

If these cannot be answered, the project should remain in discovery rather than move into expensive development.

11. Activity: Business Model Stress Test

This activity should help you test whether a research-based spin-off or TTH-supported venture can survive realistic market and institutional pressure. It should be conducted after customer discovery training and before teams present their commercialization pathway.

Instructions

8. Each team selects one technology or research result.
9. The team completes a one-page deep-tech Business Model Canvas.
10. Another team acts as the challenge panel and applies the stress conditions.
11. The presenting team must respond with evidence, not optimism.
12. The panel decides whether the model should proceed, pivot, license, seek further discovery, or stop.

Table 13 - Stress test cards

Your prototype takes 18 months longer than expected. Which funding source covers the gap and what milestone proves progress?	Users like the tool, but the buyer says no budget exists this year. Who else pays, or what lower-cost entry offer can be tested?
A competitor launches a simpler solution before you reach market. What moat or niche protects you?	Your university disagrees internally about IP ownership. What governance decision is needed before commercialization?
The pilot succeeds technically, but no one agrees to maintain it. Who is the long-term owner and what is the maintenance budget?	Regulatory approval is slower than expected. Can you enter through training, simulation, analytics, or another low-risk use case?
The strongest customer segment is not the one you expected. What evidence justifies pivoting to the new segment?	Grant reviewers like the science but criticize market readiness. Which interviews, commitments, and partner evidence will strengthen the next proposal?

Evaluation rubric for the activity

Criterion	Excellent	Satisfactory	Weak
Problem evidence	Clear, repeated evidence from target stakeholders	Some evidence, but limited segment clarity	Mostly internal assumptions
Customer and buyer logic	User, buyer, beneficiary, and blocker are distinguished	Some roles identified but buyer path unclear	Customer and payer are confused
Business model	Revenue, cost, channel, and partner logic are coherent	Business model plausible but not tested	No clear route to revenue or sustainability
Moat and IP	Defensibility is specific and realistic	Some moat mentioned but not evidenced	Patent or technology claimed as enough
TRL and funding pathway	Funding matches maturity and milestones	Funding sources listed but weak sequencing	Grant dependency with no progression logic
Decision quality	Team can justify proceed, pivot, license, or stop	Decision is plausible but evidence is thin	Team insists on original idea despite weak evidence

Recommended pre-reading and resources

Resource	How it supports the lesson
Blank, S. and Dorf, B. The Startup Owner's Manual	Customer development, startup search process, evidence-based entrepreneurship
Ries, E. The Lean Startup	Build-Measure-Learn, MVP, validated learning
Osterwalder, A. and Pigneur, Y. Business Model Generation	Business Model Canvas and business model design
EU Guiding Principles for Knowledge Valorisation	Policy logic for transforming research results into societal and economic value
European Commission Code of Practice on Intellectual Assets Management	Practical guidance for IP and knowledge valorisation
EIC Work Programme and EIC funding pages	Pathfinder, Transition, Accelerator, and TRL-aligned funding logic
EEN, EIT, EDIH and related ecosystem support pages	Partnership, scaling, skills, and digital transformation support

Lesson 2: Incubation Protocols and Minimum Viable Product (MVP)

Lesson overview. This handbook section consolidates the course material on university IP management, invention disclosure, technology assessment and the role of TTOs in moving research toward market use.

Lesson Overview

This lesson explains how a research idea is gradually shaped into a working startup inside a Technology Transfer (TT) Hub. The lesson is divided into two connected parts. The first part presents the incubation protocols, which are the structured stages that a hub uses to support founders. The second part focuses on the Minimum Viable Product (MVP), which is the tool that founders use to test whether their idea works in the real market.

Special attention is given to modern AI tools and to Vibe Coding, which today allow founders to build a first working version of their product in days instead of months. This shift is important for research-based and science-based startups, where time and money are limited resources.

Lesson Structure

1. Reading: Incubation Protocols (about 25 minutes)
2. Reading: Minimum Viable Product (about 30 minutes)
3. Reading: AI and Vibe Coding for fast MVPs (about 20 minutes)
4. Case Studies: Four examples from science-based and software startups (about 15 minutes)

5. Activity: MVP Blueprint Workshop (about 20 minutes)

Learning outcomes

- Describe the three phases of institutional incubation and the role of each phase.
- Explain how innovation is validated during the early stages of a startup.
- Apply the principles of MVP design to a research-based idea.
- Use simulation-based and consulting-based approaches when a full MVP is not yet possible.
- Identify the risks of the Valley of Death and the funding options available to cross it.
- Use AI tools and Vibe Coding to build a first working prototype with limited resources.
- Prioritise MVP features based on user value and technical risk.

Core topics

- University ownership and student inventions
- Collaborative research and shared rights
- Invention disclosure and IP assessment
- Technology valuation and market analysis
- Licensing and startup/spin-off pathways
- Academic freedom versus commercialization
- Revenue sharing and researcher incentives
- TTO services and innovation brokerage

Learning activity / reflection

Map a research result through the pathway: discovery → disclosure → assessment → protection → market analysis → licensing/startup decision → deployment.

Lesson summary

Successful transfer requires an institutional process that identifies promising research early, protects it appropriately, evaluates its market potential and connects it with capable partners.

Part 1. Incubation Protocols Explained in Simple Terms

What is an Incubation Protocol?

An incubation protocol is the set of rules, stages, and services that a TT Hub uses to help a founder move from a raw idea to a registered company. You can think of it as a structured path. At each stage of the path, the founder receives a different type of support, and the hub checks whether the project is ready to move forward.

Without a clear protocol, hubs would treat every project in the same way. With a protocol, the hub can match the right resources to the right level of maturity. For research-based projects, this is critical, because the technology is often complex and the market is not yet defined.

In practice, an incubation protocol answers three simple questions:

- Who can enter the hub, and under which conditions?
- What services and resources are offered at each stage of growth?

- How does a project graduate from one stage to the next?

These questions connect directly to the rest of this lesson. The MVP, the validation process, and the funding decisions all happen inside this structure. Without a protocol, founders may build a great product that no one needs, or waste resources before the right time.

Phase 1. Pre-Incubation

Pre-incubation is the discovery phase. At this point, the founder usually has a research result, a patent, or a strong idea, but no business model. The goal of pre-incubation is not to build a product. The goal is to test whether a real problem exists, whether someone is willing to pay for the solution, and whether the team has the skills to deliver it.

Typical activities during pre-incubation include problem interviews, basic market mapping, early prototyping on paper, and the first version of the Business Model Canvas. The hub provides mentoring, training, and access to expert networks. Funding at this stage is usually small and non-dilutive, such as grants or vouchers.

A project leaves pre-incubation when it can answer three questions clearly: What is the problem? Who has it? Is the solution technically feasible?

Phase 2. Incubation

Incubation is the building phase. The team has confirmed that the problem is real and that the technology can solve it. Now the work shifts to creating a first working version of the product, signing the first customers, and forming a legal company.

Typical services in this phase include office space, legal and IP support, technical equipment, deeper mentoring, financial planning, and introductions to potential clients. The MVP is built and tested in real conditions. Founders learn how to manage a team, how to handle contracts, and how to measure progress through clear key performance indicators.

A project leaves incubation when it has a working MVP, paying or signed pilot customers, a registered company, and a credible financial forecast.

Phase 3. Acceleration

Acceleration is the growth phase. The startup is now a real company with a product, customers, and a team. The challenge is no longer survival, but speed. The acceleration phase is designed to push the company to scale faster, often by raising external investment and entering new markets.

Services in this phase include investor readiness training, support for international expansion, advanced financial structuring, and access to venture capital networks. The hub often connects the company with strategic partners and helps the founders prepare a strong pitch deck.

A project leaves acceleration when it has secured significant investment or revenue and can grow independently from the hub.

Connecting Incubation Protocols to MVP Work

The link between incubation phases and MVP work is direct. In pre-incubation, the MVP is mostly an idea, a sketch, or a paper prototype. In incubation, the MVP becomes a working product that is

tested with real users. In acceleration, the MVP evolves into a full product with advanced features and a clear road map.

This is why a single MVP definition is not enough. The MVP must match the maturity of the project. A pre-incubation MVP is a learning tool. An incubation MVP is a selling tool. An acceleration MVP is a scaling tool.

Part 2. Minimum Viable Product (MVP)

The concept of an MVP is the cornerstone of effective product development. An MVP is the simplest version of a product or service that allows the team to gather feedback and to validate the idea with minimal effort. It is not a low quality product. It is a focused product.

A good MVP helps the team in three ways. It reduces the time needed to reach the market, it keeps costs under control, and it lowers the risk of building something that nobody wants. For founders coming from a research background, the MVP is also a way to translate complex science into something a customer can understand and use. The key characteristics of an MVP are:

- **Minimalism.** An MVP focuses on the core functionality required to solve a specific problem. It avoids extra features that do not bring direct value.
- **Quick development.** Speed is critical. The MVP must reach real users fast so the team can learn and adapt.
- **Basic design.** The design is simple and functional. Polished graphics come later, after the concept is validated.
- **Single use case.** MVPs usually target one user scenario. A narrow focus produces clearer learning.
- **User-centric.** MVPs are built around a clear understanding of user needs and pain points.
- **Iterative development.** The MVP is a starting point. It is meant to evolve based on user feedback and data.

The main benefits of an MVP are:

- **Faster time to market.** By focusing on essential features, the product reaches users sooner.
- **Cost efficiency.** A minimal version uses fewer resources than a full product.
- **Risk mitigation.** The team tests the concept with real users before making large investments.
- **Real user feedback.** Early users help the team understand what works and what does not.
- **Market validation.** A successful MVP shows investors that the demand is real.
- **Iterative improvement.** The MVP becomes the foundation for a stronger product over time.

Research-Based MVPs and Technical Feasibility

Research-based startups face a special challenge. Their core technology often requires years of research, laboratory testing, or regulatory approval. A standard software MVP, built in two weeks, is not always possible in biotechnology, advanced materials, robotics, or other science-driven fields.

In these areas, technical feasibility must be proven step by step. The team usually starts with a Proof of Concept (PoC), which shows that the science works in controlled conditions. Then a prototype demonstrates the technology in a more realistic environment. Only after that does a true MVP appear, often in the form of a service or a pilot project with a specific client.

For research-based startups, the MVP question is therefore not only "do users want it?" but also "can we deliver it reliably?". Both questions must be answered before scaling.

Simulation and Consulting-Based MVP Approaches

When a full physical or technical MVP is too expensive or too slow, founders can use lighter approaches. Two methods are very useful for research-based projects.

Simulation-Based MVP

In this approach, the team uses software simulations, digital twins, or computer models to show how the technology would behave in real conditions. Customers and investors can interact with the simulation, give feedback, and evaluate performance without waiting for the full hardware. This method is common in energy, healthcare, and engineering startups.

Consulting-Based MVP

In this approach, the team offers a manual service that uses their expertise to deliver the same value that the future product would provide. For example, a startup planning an AI tool for medical imaging may start by analysing images manually for a small group of hospitals. The team learns about the real workflow, the regulations, and the willingness to pay, while the automated product is still under development.

Both methods reduce risk and generate early revenue. They also build trust with future customers, who feel they are part of the product journey.

Resource Optimisation in Early-Stage Innovation

Early-stage innovation is defined by limited resources. Founders rarely have the people, money, or time to build everything they imagine. Resource optimisation means making careful choices about what to build, what to buy, and what to delay.

Practical principles include the following:

- Use open-source tools and existing libraries whenever possible, instead of building from scratch.
- Outsource non-core activities, such as design or accounting, to focus the team on the technology.
- Buy or rent equipment from university labs and shared facilities, instead of buying new machines.

- Choose cloud services with pay-as-you-go pricing to avoid heavy upfront infrastructure costs.
- Apply the 80/20 rule: deliver 80 percent of the value with 20 percent of the effort, and improve later.

Part 3. AI and Vibe Coding for Fast MVPs and Proofs of Concept

Vibe Coding is a recent way of building software where the developer describes the goal in plain language and an AI assistant generates most of the code. The developer guides the process, reviews the output, runs tests, and asks for changes through natural conversation. The role of the human shifts from writing every line to shaping, validating, and integrating what the AI produces.

For founders, this is a major change. A non-developer with a strong idea can now build a working web or mobile prototype in a few days. A technical founder can prototype several different versions of a product in parallel and choose the most promising one based on early user feedback.

AI tools, such as large language models, code assistants, design generators, and data analysis copilots, have changed the cost structure of early-stage innovation. Activities that used to require a small team and several weeks can now be done by one person in a few hours. This is exactly the kind of leverage that early founders need.

Advantages of Using AI and Vibe Coding

- **Speed.** A working prototype can be ready in days. This shortens the learning cycle and helps the team test more ideas in less time.
- **Lower cost.** Less code is written from scratch, and fewer specialists are needed for the first version. Budget can be saved for validation and customer development.
- **Lower entry barrier.** Researchers and domain experts who do not code can now build prototypes themselves. This keeps the team small and focused.
- **Faster experimentation.** Several MVP variants can be created and tested in parallel. The team selects the version that performs best with real users.
- **Better documentation.** AI tools can generate clean documentation, test cases, and code comments at the same time as the code itself.
- **More time for strategy.** Founders spend less time on technical setup and more time on customers, partners, and the business model.
- **Improved learning loop.** AI can summarise user feedback, analyse data, and suggest next steps. The Build-Measure-Learn cycle becomes shorter.

Limits and Responsibilities

AI tools are powerful, but they are not magic. Founders must remain critical and responsible. Generated code may contain errors, security issues, or licenses that are not safe for commercial use. Data privacy must be respected, especially in healthcare, finance, or any project involving personal information. For research-based projects, AI accelerates the software layer of the MVP, but it does not replace laboratory work, certification, or scientific validation.

A simple rule applies: AI speeds up the work, but the founder owns the result. Every important output must be reviewed before it reaches a customer or an investor.

A Practical Workflow for an AI-Assisted MVP

1. Write a clear one-page description of the problem, the user, and the value the MVP must deliver.
2. List the three most important user actions that the MVP must support. Ignore everything else for now.
3. Use an AI assistant to generate the first version of the interface and the basic logic.
4. Connect the prototype to a simple database or to a no-code backend service.
5. Test the MVP with five to ten real users. Record what they do, not only what they say.
6. Use AI to summarise the feedback and to suggest the next improvements.
7. Repeat the cycle until the MVP is good enough to present to investors or to sign the first paying customer.

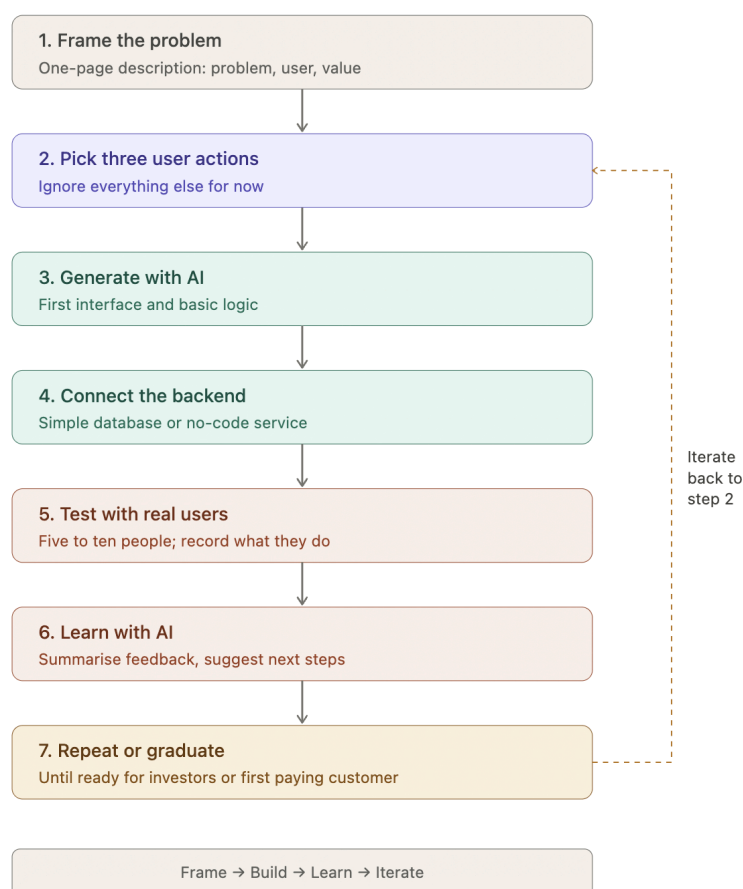


Figure 1. A practical workflow for an AI-Assisted MVP

Part 4. The Valley of Death, Funding, and Risk

The Valley of Death is the period between the first promising prototype and the moment when the startup generates enough revenue or investment to sustain itself. Many research-based projects fail in this zone, not because the technology is weak, but because money, time, and energy run out before the market is ready.

To survive the Valley of Death, founders need three things: a focused MVP that proves real value, a small but committed team, and a funding plan that combines several sources. The incubation

protocol of the hub plays a central role here, because it provides mentoring, equipment, and access to investors at the moment when internal resources are weakest.

Non-Dilutive Funding and Bridge Financing

Non-dilutive funding is money that the startup receives without giving away ownership. This includes research grants, public innovation programmes, prizes, and revenue from pilot projects. For early-stage science-based companies, this type of funding is extremely valuable, because it allows the founders to keep full control during the most uncertain period.

Bridge financing is short-term funding designed to cover the gap between two larger rounds of investment. It can come from existing investors, from convertible notes, or from short-term loans. The purpose is to keep the company alive and progressing until the next major milestone is reached.

A healthy early-stage funding plan usually combines several elements:

- Founders' own contribution and time.
- Public grants and innovation vouchers.
- Revenue from consulting or pilot projects.
- Angel investors and early venture capital, when the timing is right.
- Strategic partnerships with corporates or research institutions.

MVP Feature Prioritisation and Risk Assessment

Founders often want to include many features in the MVP. This is one of the most common mistakes. Every extra feature increases cost, delays the launch, and makes the testing process more complex. A clear method for prioritising features is essential.

A simple way to prioritise is to score each candidate feature on two dimensions:

- **User value.** How important is this feature for solving the user's main problem?
- **Implementation effort.** How much time, money, and technical risk does this feature carry?

Features with high value and low effort are included in the MVP. Features with high value but high effort may be postponed or simplified. Features with low value are removed, even if the team finds them interesting.

Risk assessment should be done at the same time. For each feature, the team can ask: What happens if this feature does not work? What happens if a competitor offers it for free? What happens if the regulation changes? A short written answer to these questions helps the team make better decisions and protects the company from surprises.

Part 5. Case Studies in Science-Based and Software Startups

The four case studies below illustrate how the same principles apply across very different industries. Pay attention to the role of the incubation phase, the chosen MVP approach, the use of AI or Vibe Coding, and the way the team handled the Valley of Death.

Case Study 1. A University Spin-Off in Medical Imaging

A research team at a European university developed a new algorithm for detecting early signs of lung disease in CT scans. The technology was strong, but the path to market was unclear. During pre-incubation, the team conducted forty interviews with radiologists, hospital managers, and insurance providers. They discovered that the highest value was not in the algorithm itself, but in the time saved per diagnosis.

In the incubation phase, the team used a consulting-based MVP. They offered manual analysis services to two hospitals while the automated system was being built. This generated early revenue and produced a strong dataset for training the model. AI tools were used to accelerate the development of the user interface and to summarise feedback from radiologists. The startup later raised a seed round and entered the acceleration phase with a registered company, a working product, and three pilot customers.

Lesson learned: a consulting MVP, combined with AI tools and a clear incubation path, turned a research result into a commercial product in less than two years.

Case Study 2. A Hardware Startup in Clean Energy

A team of engineers designed a new type of battery management system for renewable energy storage. The hardware required laboratory testing and regulatory certification, which would take several years. To survive the Valley of Death, the team used simulation-based MVPs to demonstrate performance to potential clients, and Vibe Coding to build a software dashboard that customers could test on existing systems.

They combined non-dilutive funding from a national innovation agency with a small angel investment. By the end of the incubation phase, the startup had three signed letters of intent, a working software product, and a clear road map for the certified hardware. The acceleration phase focused on scaling the software side first, while the hardware moved through certification in parallel.

Lesson learned: when full hardware MVPs are slow and expensive, simulation and software-based MVPs can keep the company alive and attract customers.

Case Study 3. An AI-Powered Customer Support Platform

Two software engineers identified a clear problem in small and medium businesses. Customer support teams were overloaded with repetitive questions, and existing chatbots produced poor answers. The founders wanted to build a platform where each business could deploy a customised AI assistant trained on its own documents, with a human agent always one click away.

During pre-incubation at the TT Hub, they tested the idea with twenty business owners and discovered that the real pain was not the chatbot itself, but the time needed to set it up. Based on this insight, they reshaped the MVP around a five-minute setup flow, not around advanced AI features.

They then applied Vibe Coding to build the entire MVP in three weeks. The frontend, the backend, and the integration with a large language model were generated through AI assistants, while the founders focused on the user interface and the onboarding experience. The MVP was deployed

as a web application, and the first ten customers signed up within a month of launch. The team used the early revenue to cover the cloud costs and to hire a part-time designer.

By the end of the incubation phase, the company had fifty paying customers, a clear pricing model, and detailed usage data. The team raised a small seed round to scale the platform internationally. The total budget spent from idea to seed funding was lower than the cost of a single senior developer hired for one year.

Lesson learned: when the problem is well defined and the technology stack is mature, AI tools and Vibe Coding can compress an entire incubation cycle into a few months. The competitive advantage lives in the user experience and in the deep understanding of the customer, not in the code.

Case Study 4. A SaaS Platform for Research Data Management

A computer science researcher noticed that her colleagues spent many hours organising experimental data across different folders, files, and tools. She decided to build a software platform that would automate data collection, version control, and sharing inside research labs.

The idea was promising, but the founder had no business experience and a small team of two part-time developers. The TT Hub accepted the project into pre-incubation and provided mentoring, a small grant, and access to potential customers in three partner universities.

Instead of building a full platform, the team started with a consulting-based MVP. They worked with two research groups in person, listened to their workflows, and used AI coding assistants to build small scripts that solved specific pain points. Each script was then generalised and added to a growing library of features. After six months, the library became the first version of the platform.

The transition to incubation happened when the team signed a paid contract with a national research institute. The funding model combined a European Union research grant with a subscription fee from the institute. AI tools continued to play a central role, both for generating new platform features and for analysing how researchers actually used the product.

The startup did not pursue venture capital at this stage. Instead, the founders chose a slower but more independent growth path, financed by grants and subscriptions. By the end of the second year, the platform was used by more than thirty research groups across Europe, and the team had grown to seven people.

Lesson learned: not every startup needs to follow the venture capital route. A research-friendly business model, combined with consulting MVPs and AI-assisted development, can build a sustainable software company at a steady pace, especially within an academic ecosystem.

Cross-Case Reflection

Looking at the four cases together, several patterns appear. First, every successful team started with deep customer understanding before writing serious code or buying expensive equipment. Second, the MVP format was chosen to match the constraints of the technology, not the personal preferences of the founders. Third, AI tools and Vibe Coding played a different role depending on the field, but in every case they reduced the cost of experimentation. Fourth, the incubation protocol of the TT Hub provided the structure that allowed the team to move from one phase to the next without losing momentum.

Activity: MVP Blueprint Workshop

Estimated time: 20 minutes for the core blueprint, plus optional sections that can be completed during the week. Format: individual or small group, written submission on Moodle.

The MVP Blueprint Workshop is the practical bridge between this lesson and the next one on investor readiness. By the end of this activity, you will have a structured document that summarises your idea, your users, your MVP plan, your risks, and your next steps. This document will be reused, expanded, and refined throughout the rest of the course.

Document Submission Format

The workshop is divided into eight sections. Sections 1 to 4 are required and should be completed during the lesson. Sections 5 to 8 are optional but strongly recommended, and can be finished before the next lesson. Each section can be answered in a few sentences. The total length of the final document should be between two and four pages.

Section 1. The Problem and the User

1. Describe the problem you want to solve in one or two sentences. Use plain language, as if you were talking to a friend who is not a specialist.
2. Identify the main user of the future product. Give this user a name, a role, and a short description (age range, profession, context).
3. Describe one specific situation in which this user faces the problem. Where are they? What are they trying to do? Why does it become difficult?
4. Estimate how often this situation happens: daily, weekly, monthly, or rarely.

Section 2. The Value Proposition

1. Complete the following sentence in your own words: "For [type of user], our product helps to [main benefit], unlike [current alternative], because [unique advantage]."
2. List the three most important reasons why a user would choose your solution over what they use today.
3. Identify what would happen if your product did not exist. What is the cost of inaction for the user?

Section 3. MVP Definition and Core Features

1. List between three and five core features that your MVP must include. For each feature, write one short sentence on the value it brings to the user.
2. List between two and four features that you will deliberately leave out of the MVP. For each one, write one short sentence on why it can wait.
3. Indicate the current incubation phase of your project: pre-incubation, incubation, or acceleration. Justify your choice in one sentence.
4. Decide which MVP approach fits best: full prototype, simulation-based MVP, consulting-based MVP, or a combination. Explain why in two sentences.

Section 4. AI and Vibe Coding Plan

1. Describe how AI tools or Vibe Coding could speed up your MVP. Give at least three concrete examples (for instance: generate the user interface, draft the database schema, write test cases, summarise interviews, create marketing copy, or analyse early data).
2. List the parts of the MVP that should not be delegated to AI tools. Explain why a human must own them (for example: ethical decisions, scientific validation, sensitive data, regulatory content).
3. Estimate how many days you need to produce a first usable version of the MVP using AI-assisted development. Compare this with the time it would take without AI tools.

Section 5. Validation Plan (Optional)

1. Define how you will measure success during the first MVP test. Choose between two and four indicators (for example: number of sign-ups, time on task, conversion rate, customer interviews completed, paying pilot customers).
2. Describe how you will find your first ten test users. Where do they spend their time? Which communities, events, or networks can you use?
3. Define a clear stop rule. What result would tell you that the idea is not working and that you should pivot or stop?

Section 6. Funding and Resource Plan (Optional)

1. List the main resources your MVP needs: people, money, time, equipment, and data.
2. Identify at least two sources of non-dilutive funding that match your project (national grants, European Union programmes, innovation vouchers, prizes, university support).
3. Estimate the total budget needed to take the MVP from today to the first paying customer.
4. List two strategies you would use to extend your runway if funding is delayed.

Section 7. Risk and Assumption Map (Optional)

1. List the three most important assumptions behind your idea. An assumption is something you currently believe is true but have not yet proven.
2. Rank these assumptions by risk. The riskiest assumption is the one that would most damage the project if it turned out to be wrong.
3. For each of the top two risks, propose one concrete action that would reduce the risk within the next four weeks.

Section 8. Next Steps and Personal Commitment (Optional)

1. Write down the three most important actions you will take within the next two weeks to move your MVP forward.
2. For each action, indicate who is responsible, the deadline, and the expected output.
3. Write one sentence describing what success will look like at the end of those two weeks.

Submission and Evaluation

Upload your MVP Blueprint as a single PDF or Word document to the Moodle activity area. The minimum required content is Sections 1 to 4. Submissions that include the optional sections will receive more detailed feedback from the instructor.

The blueprint will be reviewed against four criteria:

- Clarity of the problem and the user.
- Focus of the MVP and quality of the feature choices.
- Realism of the AI and Vibe Coding plan.
- Awareness of risks, assumptions, and resource limits.

Suggested Materials and Further Reading

The following materials offer additional depth on the topics covered in this lesson. They are grouped into four categories. Each entry includes the title, the author or organisation, and a link where the resource can be accessed or purchased.

- **The Lean Startup.** Eric Ries. Crown Business. <https://theleanstartup.com/>
- **The Mom Test.** Rob Fitzpatrick. <https://www.momtestbook.com/>
- **AI Engineering.** Chip Huyen. O'Reilly Media. <https://www.oreilly.com/library/view/ai-engineering/9781098166298/>
- **Designing Machine Learning Systems.** Chip Huyen. O'Reilly Media. <https://www.oreilly.com/library/view/designing-machine-learning/9781098107956/>
- **Claude documentation and developer guides.** Anthropic. <https://docs.claude.com/>
- **GitHub Copilot documentation.** GitHub. <https://docs.github.com/en/copilot>
- **Cursor editor and AI coding workflows.** <https://www.cursor.com/>

Resources on Funding, Innovation Programmes, and TT Hubs

- **European Innovation Council (EIC).** <https://eic.ec.europa.eu/>
- **Horizon Europe funding and tenders portal.** <https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/home>
- **EIT (European Institute of Innovation and Technology).** <https://eit.europa.eu/>
- **Enterprise Europe Network.** <https://een.ec.europa.eu/>
- **500 Global resources and articles.** <https://500.co/>

Lesson 3: Investor Readiness, Market Strategy, and Growth Planning

Lesson overview. The course material also addresses advanced perspectives on open innovation, AI and IP, sustainability, ethical commercialization and the practical challenges faced by innovation ecosystems.

Learning outcomes

- Distinguish between the main sources of early-stage capital (angels, venture capital, grants, and non-dilutive funding) and select the right type of investor for a given stage.
- Read and reason about a simple capitalization table, and explain how founder vesting, option pools, and dilution shape ownership over time.
- Construct a compelling, story-driven investor narrative and translate it into a structured pitch deck.
- Design a go-to-market (GTM) strategy, including ideal customer profile, channels, pricing, and the choice between product-led and sales-led motions.
- Map the regulatory and quality-standard requirements (ISO, FDA, EMA where relevant) that affect market access for an innovation.
- Build a milestone-based growth roadmap that links funding rounds to measurable KPIs.
- Compare the principal exit pathways (acquisition, IPO, secondary sale, buyout) and articulate a realistic exit thesis.

Integrate all of the above into an investor-ready package for a research-based venture.
Core topics

- Open innovation and collaborative research
- AI and intellectual-property questions
- Data, privacy and algorithmic responsibility
- Sustainability and ESG considerations
- Responsible research and innovation
- Access, inclusion and humanitarian approaches
- Innovation ecosystem maturity and support mechanisms

Learning activity / reflection

Discuss whether a legally protectable technology should always be commercialized. Consider scientific, economic, ethical, environmental and societal dimensions.

Lesson summary

Technology-transfer decisions should consider not only whether an innovation can be commercialized, but also whether it should be commercialized, under what conditions and with what safeguards.

Introduction and How to Use This Lesson

Most innovations do not fail because the science is weak. They fail because the team never crosses the gap between a working idea and a fundable, scalable company. By the time you reach this lesson, you have already done the hard early work of the programme: you have validated an

innovation, sketched an MVP, and drafted a business model. This lesson is about everything that happens next making your venture investable, taking it to market, and planning how it will grow and, eventually, exit.

Who this lesson is for. This material is written for a mixed cohort: university researchers exploring a spin-out, early-stage founders inside an incubator or accelerator, and staff working in technology transfer offices (TTOs) and innovation ecosystems. Wherever a concept is especially relevant to one of these groups, the text flags it explicitly.

How the lesson is structured. The lesson is organised into eight thematic sections, each combining concise theory, a worked example, and a short hands-on activity. A single running case study *VoltWise*, a SaaS startup spun out of a university energy-systems lab threads through every section so you can see each concept applied to one venture. The lesson closes with a step-by-step practical assignment that asks you to take a different research idea all the way from the lab bench to an investor-ready startup.

How to work through this lesson on Moodle

- **Read each section in order.** Concepts build on one another: equity feeds the pitch, the pitch feeds the raise, the raise feeds the growth plan.
- **Pause at each “Activity” box.** These are short (10–30 minutes) and are designed to be posted to the Moodle forum or saved to your workbook.
- **Follow the VoltWise example.** It shows you what “good” looks like before you produce your own version.
- **Complete the final assignment.** It is cumulative each step reuses what you produced earlier.

Meet the running case: VoltWise

VoltWise began as a research project in a university energy-systems laboratory. The team led by Dr. Lena Park, a postdoctoral researcher, and co-founded with a software engineer, Marco Reyes developed a machine-learning model that predicts and reduces energy consumption in commercial buildings by continuously optimising heating, ventilation, and cooling. Peer-reviewed trials in two campus buildings cut energy use by 18%. With support from the university’s Technology Transfer Office, the team licensed the underlying algorithm and incorporated VoltWise Inc. as a B2B Software-as-a-Service company that sells a subscription dashboard to commercial real-estate operators. We will follow VoltWise from its first angel cheque through to a planned exit.

1. The Investment Landscape: Angels, Venture Capital, and Beyond

Before you ask anyone for money, you need to understand who gives it, on what terms, and at what stage. “Investors” is not one homogeneous group. The two best-known sources of equity capital angel investors and venture capitalists differ in almost every meaningful dimension: the size of cheque they write, the stage at which they invest, how fast they decide, how much control they expect, and whose money they are actually risking.

1.1 Angel investors

An angel investor is a high-net-worth individual who invests their own personal capital into early-stage companies, usually in exchange for equity. Angels typically write cheques between roughly

\$10,000 and \$500,000, and they invest at the earliest stages pre-seed and seed often when a company has little more than a prototype and a credible team. Because they are deploying their own money, angels can decide quickly (days or weeks rather than months), and many bring valuable operating experience, mentorship, and industry connections alongside the cash. Angels increasingly invest through syndicates and angel networks, pooling several individuals into a single, larger round.

1.2 Venture capitalists

A venture capitalist (VC) is a professional investor who manages a pooled fund that is, other people's money, raised from limited partners such as pension funds, endowments, and family offices. VCs write larger cheques, typically from around \$1 million at seed up to many millions at later stages, and they invest with a fiduciary duty to generate returns for their fund. Because of this duty, VCs run a more formal process: detailed due diligence, term sheets, board seats, and governance rights. Their decisions take longer (often months), and they expect a clear path to a large outcome that can return their fund.

1.3 Side-by-side comparison

Dimension	Angel Investor	Venture Capitalist
Source of money	Own personal wealth	Pooled fund (limited partners' money)
Typical cheque	~\$10K – \$500K	~\$1M – \$10M+ per round
Stage	Pre-seed / seed	Seed through growth (Series A onward)
Decision speed	Days to weeks	Weeks to months
Due diligence	Light, relationship-driven	Formal, structured, legal
Control / governance	Usually minimal	Board seats, protective provisions
What they add	Mentorship, network, speed	Capital scale, hiring, follow-on funding

Sources: Stripe (2024); Gilion; Angel Capital Association (2025); PitchDrive (2025).

1.4 Other sources of capital you should know

Equity from angels and VCs is only part of the picture, and for research-based ventures it is often not the first money in. Three other sources matter:

- **Non-dilutive funding (grants).** Public research grants, innovation agencies (e.g., Horizon Europe, national innovation funds), and university proof-of-concept funds give money without taking equity. For TTO-backed spin-outs, this is frequently the first and most important source.
- **Accelerators and incubators.** Programmes that provide small amounts of capital, intensive mentorship, and a cohort, usually in exchange for a small equity stake.
- **Revenue and customer-funded growth.** The cheapest capital of all is a paying customer. Many durable companies fund early growth from revenue before raising institutional money.
- **Venture debt and convertible instruments.** Loans or convertible notes/SAFEs that defer the valuation conversation to a later round.

VoltWise in practice

VoltWise's first \$40,000 came as a **non-dilutive proof-of-concept grant** from the university's innovation fund enough to turn the research prototype into a deployable pilot. Once two paying pilot customers were live, the founders raised a **\$350,000 angel round** from three local angels

(one a former facilities-management executive who became a mentor). They deliberately delayed approaching VCs until they had recurring revenue, because at the seed stage the angels' speed, sector knowledge, and lighter terms suited them far better than a formal VC process.

Activity 1.1 Map your capital path (15 min)

For your own venture (or for the assignment case), list the realistic capital sources for the next 18 months. For each, note: the typical cheque size, what you would give up, and what non-financial value it brings. Decide which source you would approach first, and write one sentence justifying why.

2. Capital Structure, Equity, and Founder Vesting

Raising money means selling part of your company. To do that without harming yourself, your co-founders, or your future, you need to understand three connected ideas: the capitalization table (who owns what), founder vesting (how ownership is earned over time), and dilution (how ownership shrinks as you raise more money).

2.1 The capitalization table ("cap table")

A cap table is simply the record of who owns what percentage of the company. It lists founders, employees with stock options, and investors, and it is the single source of truth for ownership. A clean, well-maintained cap table is not just administrative housekeeping: investors inspect it closely, because a messy cap table with unclear ownership, too many small shareholders, or large chunks held by people no longer involved can make a company effectively un-fundable.

2.2 Founder vesting and the cliff

It might seem strange that founders do not simply own their shares outright on day one. The reason is alignment. Founder vesting means founders earn their equity over time, usually over four years with a one-year "cliff." In a standard schedule, nothing vests during the first year; at the one-year mark, 25% of the shares vest at once (the cliff); and the remaining shares then vest in equal monthly amounts over the following three years.

Vesting protects everyone. If a co-founder leaves after three months, vesting ensures they do not walk away with a large permanent slice of the company their unvested shares return to the company. This protects the remaining founders from dilution and reassures investors that the people building the company are committed to staying. Investors almost always require founder vesting as a condition of investment.

Time since start	Shares vested (4-yr / 1-yr cliff)	What it means
Months 0–11	0%	Nothing vests yet the cliff period
Month 12 (cliff)	25% all at once	First year of commitment is rewarded
Months 13–48	+1/48 each month	Steady monthly vesting to 100%
Month 48	100%	Fully vested

A standard four-year vesting schedule with a one-year cliff. Sources: Rho (2025); Carta; Cake Equity.

2.3 Dilution: owning less of more

Every time you issue new shares to investors, existing owners' percentages shrink. This is dilution. If founders own 100% and sell 20% to investors, the founders now collectively own 80%. This is not necessarily bad: the goal is to own a smaller slice of a much larger pie. A common reference point is that median founder-team ownership falls to roughly 36% after a Series A round, with software founders often retaining a little more. The skill is to raise only what you need at each stage, hit value-creating milestones between rounds, and so raise each subsequent round at a higher valuation minimising the ownership you give away for each dollar.

The option pool. Investors also expect you to set aside an “option pool” typically 10–20% of equity reserved to hire and reward early employees. This pool dilutes the founders, so where it sits in the negotiation (created before or after the investment) materially affects founder ownership.

VoltWise in practice

At incorporation, the two VoltWise founders split equity 55/45 in Dr. Park's favour (she contributed the core research and IP), both on a standard four-year / one-year-cliff schedule. The university's TTO took a 5% founder-stake in exchange for the IP licence a common arrangement for spin-outs. After the \$350K angel round priced the company at a \$2.5M post-money valuation, the angels took 14%, and a 12% option pool was created. The founders' combined stake fell from 95% to roughly 64% a textbook example of dilution in exchange for fuel.

Activity 2.1 Build a one-line cap table (20 min)

Create a simple cap table for your venture at three moments: (a) at incorporation, (b) after a 12% option pool is created, and (c) after an angel round in which investors take 15%. Show each founder's percentage at each stage. Then write two sentences on what surprised you about how quickly ownership changes.

3. Investor Pitching and Storytelling

Investors do not fund spreadsheets; they fund people and stories they believe in. Research is striking on this point: stories are remembered up to 22 times more than facts alone, and experienced investors consistently say they back founders and narratives, not just numbers. A strong pitch wraps your data inside a story that makes the investor feel the problem, believe in your solution, and sense that the opportunity is inevitable.

3.1 Why storytelling works

A good investor story does three jobs at once. It answers “Why should I care?” (the problem), “Why should I believe?” (the proof), and “Why should I join?” (the opportunity). It also conveys four emotional signals that investors look for: conviction (you are certain this matters), inevitability (this will happen, with or without them), founder-market fit (you specifically are the right person to solve it), and connection (it resonates on a human level).

3.2 A simple narrative framework

You do not need a Hollywood script. A reliable structure that maps cleanly onto a deck is the problem → solution → proof → path → ask arc:

1. Start with one real person experiencing the problem a concrete story, not an abstract market chart.

2. Introduce your solution as the natural answer to that pain.
3. Show proof that it works traction, pilots, data, retention.
4. Lay out the path how this becomes a large, scalable business.
5. Make the ask what you need and what it will achieve.

Tell your origin story. Especially for researchers, the most powerful slide is often “why you.” Not “I spotted a market opportunity,” but “I spent six years in the lab watching this exact problem waste energy and money, and I could not stop thinking about it.” That earns the founder-market-fit signal that no financial model can.

VoltWise in practice

VoltWise opens its pitch not with technology but with a person: “Meet Sara, who runs facilities for a 40-floor office tower. Every month she gets an energy bill she cannot explain and cannot control.” Only then does Dr. Park introduce the model, the 18% energy reduction from the campus trials, and the two paying pilots. The origin story a researcher who measured this waste building by building makes the founder-market fit obvious. The narrative arc carries the room before a single financial slide appears.

Activity 3.1 Write your cold-open (15 min)

Write the opening 60 seconds of your pitch as a single human story one named person feeling the problem your venture solves. Then write one sentence of origin story explaining why you are uniquely positioned to solve it. Avoid all jargon.

4. Building an Effective Investor Deck

The pitch deck is the document that carries your story into the investor’s inbox and the meeting room. The data is sobering: investors skim an initial deck in just three to four minutes, and they spend roughly three times longer on the traction slide than any other. A good deck is therefore short (10–16 slides), front-loads clarity, and earns the “ask” through everything that comes before it.

4.1 The standard slide sequence

Decks vary, but a widely used 12-slide structure works for almost any early-stage company:

#	Slide	What it must answer
1	Cover / one-liner	Who you are in one sentence
2	Problem	Whose pain, how big, how real
3	Solution	How you remove that pain
4	Product / demo	What it actually looks like
5	Market size (TAM/SAM/SOM)	How big this can get built bottom-up
6	Business model	How you make money
7	Traction	Proof it is working (the slide they study)
8	Go-to-market	How you reach customers
9	Competition	Why you win
10	Team	Why you are the ones to do it
11	Financials	Where this goes over 3 years
12	The Ask	How much, for what milestones

Sources: Slidebean; Venngage; Qubit Capital (2025); DocSend Pitch Deck Report (2025).

4.2 Sizing the market without lying

The market-size slide is where many founders lose credibility. Avoid the top-down “we only need 1% of a \$50 billion market” claim, which signals you have not thought hard. Build it bottom-up instead: number of realistic customers × the price they pay. For example, “5,000 reachable customers × \$20,000 average annual contract = \$100M serviceable market” is concrete and defensible. Place this slide right after the problem, so the investor feels the scale before seeing your solution.

4.3 The traction slide

Because investors study traction more than anything else and most “no” decisions cite weak traction lead with a single honest headline metric (recurring revenue growth, active-user growth, or signed letters of intent), then support it with two or three proofs such as retention, named customer logos, or partnerships. Never pad it with vanity metrics.

VoltWise in practice

VoltWise’s traction slide leads with one number: “\$9K MRR, growing 22% month over month.” Beneath it sit three proofs 96% pilot retention, two named real-estate logos, and a signed letter of intent from a regional property manager covering eleven buildings. Its market slide is bottom-up: “~12,000 mid-sized commercial buildings in our launch region × \$15K average annual contract = ~\$180M serviceable market.” The Ask slide closes the loop: “Raising \$1.2M to reach \$1M ARR and Series-A readiness in 18 months.”

Activity 4.1 Draft your traction and ask slides (25 min)

Produce two slides in outline form. (1) A traction slide with one headline metric and three supporting proofs use real or realistic numbers. (2) An ask slide that states how much you are raising and ties it to two or three concrete milestones. Keep each slide to no more than five lines.

5. Go-to-Market and Market Entry Strategy

A go-to-market (GTM) strategy is your plan for how you will reach customers and get them to buy. A brilliant product with no GTM strategy is a hobby. The strategy answers four linked questions: who exactly is the customer, through which channels will you reach them, how will you price, and which sales motion will you use?

5.1 Define the customer: ICP and personas

Start narrow. Your Ideal Customer Profile (ICP) describes the kind of organisation you sell to its size, sector, and characteristics. Within that ICP, buyer personas describe the actual people involved: the user who lives with the problem, the economic buyer who signs the cheque, and any gatekeepers in between. Early-stage companies that try to sell to everyone usually sell to no one; the discipline is to pick a beachhead segment and dominate it before expanding.

5.2 Choose the sales motion

There is no single right motion the choice depends largely on price. A useful heuristic based on annual contract value (ACV):

Annual contract value	Recommended motion	What it looks like
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Under ~\$5,000	Product-led growth (PLG)	Self-serve sign-up, free trial, the product sells itself
~\$5,000 – \$50,000	Demand-gen + inside sales	Marketing generates leads; a small sales team closes remotely
Over ~\$50,000	Account-based + field sales	Targeted accounts, relationships, in-person selling

A widely used GTM heuristic linking price to motion. Sources: York IE; Stripe; Highspot (2026).

5.3 Channels, pricing, and the GTM table

Pick a small set of primary channels where your ICP actually spends time search, paid social, outbound email, events, integrations and marketplaces, or partner co-marketing rather than spreading thinly across all of them. Pricing should reflect the value delivered and the buyer's expectations, not just your costs. A practical way to pull this together is a GTM table that maps each market segment to its channel, price, and the metric you will watch.

Segment	Primary channel	Pricing	Key metric
Beachhead: mid-size offices	Outbound + referrals	\$15K / yr per building	Pilots converted to paid
Expansion: property managers	Partner co-marketing	Volume tiers	Buildings per account
Future: facility-mgmt firms	Channel / integrations	Revenue share	Partner-sourced ARR

Example GTM table for VoltWise.

5.4 Market entry and expansion

Once your beachhead works, expansion follows one of a few logics: geographic rollout (new cities or countries), vertical expansion (adjacent industries with the same pain), or channel-led growth (letting partners carry you into markets you could not reach alone). The principle is the same as with funding: prove one motion works before layering on the next.

VoltWise in practice

VoltWise picked a sharp beachhead: mid-sized commercial office buildings in one metropolitan region, where energy costs are high and a single facilities manager makes the buying decision. With a \$15K annual contract, it sits in the demand-generation-plus-inside-sales band too expensive for pure self-serve, too cheap for field sales. Its first channels were targeted outbound email and warm referrals from the angel who knew the sector. Only after proving this motion did it plan expansion through property-management partners.

Activity 5.1 Build your GTM table (25 min)

Define your ICP in one sentence and name your single beachhead segment. Then complete a GTM table with at least one row (segment × channel × pricing × key metric). Using the ACV heuristic, state which sales motion fits your price point and why.

6. Regulatory Compliance and Quality Standards

Regulation is rarely the first thing founders think about and that is exactly why it sinks so many ventures late in the game. Market access often depends on meeting quality standards and regulatory requirements, and investors increasingly treat a credible compliance plan as a sign of maturity. The specifics depend heavily on your sector: a pure-software SaaS company faces a

very different stack from a medical-device or pharmaceutical spin-out. The goal of this section is to help you identify which requirements apply to you and to plan for them early.

6.1 Think in terms of a “compliance stack”

A useful mental model is a layered compliance stack, from general to specific:

- **Foundational quality management ISO 9001.** A general standard for quality-management systems (QMS) applicable to almost any organisation; it signals you have repeatable, documented processes.
- **Domain-specific quality standards.** For medical devices, ISO 13485 builds on ISO 9001 with requirements specific to patient safety and risk management. For information security highly relevant to any SaaS handling customer data ISO 27001 is the equivalent benchmark.
- **Sector regulators.** In life sciences, the U.S. Food and Drug Administration (FDA) and the European Medicines Agency (EMA) set binding rules; the FDA’s Quality Management System Regulation now incorporates ISO 13485 by reference, and the EU MDR/IVDR require an aligned quality system.
- **Data and privacy regulation.** For software companies, frameworks such as the EU’s GDPR govern how you collect and process personal data often the single most important compliance area for a SaaS startup.

Standard / regulator	Domain	Why it matters to a startup
ISO 9001	General quality management	Baseline credibility; repeatable processes
ISO 13485	Medical devices	Required for device market access; implies FDA/EMA alignment
ISO 27001	Information security	Key trust signal for any SaaS handling data
FDA / EMA	Drugs & devices	Binding market authorisation in US / EU
GDPR (and similar)	Data privacy	Mandatory for handling EU personal data

Sources: FDA QMSR; ISO; BSI; SimplerQMS (2025); ArisGlobal.

6.2 Why compliance is a growth and fundraising asset

Founders often see compliance as a cost. Reframe it: standards like ISO 13485 or ISO 27001 demonstrate quality to customers, reduce the risk of recalls or breaches, build investor trust, and form the foundation for expanding into international markets where certification is a precondition of selling. For research spin-outs in regulated fields, a clear regulatory pathway is frequently the difference between a fundable company and an interesting science project.

VoltWise in practice

As a pure-SaaS company, VoltWise faces no FDA or EMA exposure but it does handle building-level operational data for enterprise customers. Its compliance priorities are therefore **ISO 27001** (information-security management) and **GDPR** compliance, because enterprise real-estate clients will not sign without security assurances. VoltWise budgeted for a SOC 2 / ISO 27001 readiness assessment as part of its seed round turning a compliance cost into a sales accelerator that shortens enterprise procurement.

Activity 6.1 Build your compliance stack (20 min)

List the standards and regulators that apply to your venture, ordered from foundational to sector-specific. For each, note whether it is a market-access requirement, a trust signal, or both, and roughly when in your roadmap you must address it. Identify the single compliance item most likely to block a sale if ignored.

7. Startup Growth, Scaling, and Funding Milestones

Growth is not the same as scaling. Growth means adding revenue by adding resources at the same rate. Scaling means adding revenue much faster than you add cost the economics that make a startup valuable. To scale deliberately, founders link each funding round to a set of milestones and KPIs, so that every dollar raised buys measurable progress toward the next round.

7.1 A holistic view of scaling

Scaling is not only a finance problem. A useful model the Scaling Wheel treats scaling as the simultaneous development of five areas: team, customer, product, finance, and operations. A company that races ahead on customers while neglecting operations, or raises money without the team to deploy it, scales unevenly and breaks. The complementary, founder-first view emphasises capital-efficient growth: using customer revenue to fund as much progress as possible, so you raise less and retain more equity.

7.2 The funding-milestone ladder

Each stage of funding answers a different question and expects different evidence. The table below summarises typical expectations for a SaaS company figures vary by region and market cycle, so treat them as orientation, not gospel.

Stage	Core question	Typical signals investors expect
Pre-seed	Is the idea real?	Prototype, founding team, early validation
Seed	Do people want it?	Early revenue (~\$300K–\$500K ARR), product-market-fit signals
Series A	Can it scale?	\$1M–\$2M+ ARR, 2–3x YoY growth, LTV:CAC > 3:1
Series B+	Will it dominate?	Repeatable GTM, expanding margins, market leadership

Sources: Qubit Capital (2025); Visible.vc; Mercury; PhoenixStrategy (2025).

7.3 The KPIs that matter

For a subscription business, a handful of metrics tell investors almost everything:

- **ARR / MRR** (annual / monthly recurring revenue) the headline of scale.
- **Growth rate** month-over-month or year-over-year; seed-stage investors look for strong double-digit monthly growth, and a “triple, triple, double, double” annual trajectory is a famous benchmark.
- **CAC and LTV:CAC ratio** customer acquisition cost versus lifetime value; a ratio above 3:1 signals healthy unit economics.
- **Churn / retention** whether customers stay; high churn quietly kills otherwise fast-growing companies.

Mind the gap. Only an estimated 20–30% of seed-funded startups go on to raise a Series A the so-called “Series A crunch” and the median time from seed to Series A has stretched to around 19 months. Plan your runway and milestones with that reality in mind.

VoltWise in practice

VoltWise built a milestone roadmap tied to its raise. The \$1.2M seed round is explicitly mapped to three milestones over 18 months: reach \$1M ARR, prove an LTV:CAC ratio above 3:1, and complete ISO 27001 readiness. Each milestone is what a Series-A investor will want to see, so the seed round is, in effect, the down-payment on Series-A readiness. The founders track ARR growth, net revenue retention, and CAC payback monthly, and report them to their angels in a one-page update.

Activity 7.1 Draft your milestone ladder (25 min)

Create a table with your next two funding stages. For each, state the core question, the amount you would raise, the milestones that money buys, and the two or three KPIs you will report. Then identify your single most important KPI for the next 12 months and explain why.

8. Exit Strategies: Planning the Endgame

An exit is the event that lets founders and investors convert their equity into cash or liquid shares. Investors fund startups expecting an exit, so even at the earliest stage you should have a credible if provisional view of how yours might happen. The three principal paths are acquisition (someone buys you), an initial public offering (you list on a stock exchange), and various forms of secondary sale or buyout.

8.1 The reality of exits

The data corrects a common myth. Most founders dream of an IPO, but the overwhelming majority of successful exits are acquisitions. Mergers and acquisitions (M&A) have historically accounted for over 85% of venture-backed exits, and recent data shows M&A representing roughly three-quarters of US exits while IPOs are under 4%. In some years, companies are acquired nearly ten times as often as they go public. The median age at IPO has climbed to around 13.5 years IPOs are rare, slow, and expensive. Planning to be acquired is therefore the realistic base case for most startups.

8.2 Comparing the paths

Exit path	What happens	When it fits	Trade-offs
Acquisition / M&A	A larger company buys you	Most common; strategic fit, faster	Loss of independence; price varies
IPO	Shares listed publicly	Large, mature, high-growth firms	Costly, slow, heavy disclosure, lock-ups
Secondary sale	Shareholders sell stakes privately	Interim liquidity without full exit	Often discounted; partial
Buyout (MBO/PE)	Management or PE buys control	Stable, profitable companies	May cap upside

Sources: J.P. Morgan; PitchBook; ScienceDirect; MaRS; SVB.

8.3 Build-to-acquire vs build-to-IPO

Your exit thesis should shape how you build. A build-to-acquire company focuses on becoming strategically valuable to a clear set of potential acquirers owning a technology, customer base, or capability that a larger player would rather buy than build. A build-to-IPO company must reach the revenue scale, growth rate, predictability, and operational infrastructure that public markets demand, which takes far longer. For research spin-outs especially, acquisition by an industry

incumbent is often the most natural path, because the incumbent gains proven technology and the founders gain a route to scale they could not reach alone.

Readiness matters. Whichever path you target, exits reward preparation: a clean cap table, organised financials and contracts, protected intellectual property, and documented processes. M&A deals routinely take six to twelve months of due diligence, and disorganisation lowers the price or kills the deal. The compliance and cap-table discipline from earlier sections pays off precisely here.

VoltWise in practice

VoltWise frames its exit thesis honestly to investors: “build-to-acquire.” Its most likely acquirers are large building-management and HVAC companies, and enterprise energy-software platforms, all of whom would rather buy a proven optimisation engine with live customers than build one. The founders therefore prioritise defensible IP (licensed from the university and extended in-house), named enterprise logos, and clean financials the assets an acquirer’s due-diligence team will examine. An IPO is mentioned only as a long-term, lower-probability scenario.

Activity 8.1 Write your exit thesis (15 min)

In one short paragraph, state your most likely exit path and why. Name three realistic acquirers (or explain why an IPO is plausible). Then list the three assets you must build now to be attractive at exit and connect each back to an earlier section of this lesson.

9. Final Practical Assignment: From Research Idea to Investor-Ready Startup

This assignment is the practical heart of the lesson. Working individually or in small teams, you will take a single research idea and carry it, step by step, through the full journey of becoming an investor-ready startup inside a Technology Transfer Hub. Each step reuses what you produced earlier, so by the end you will have assembled a complete startup package. The assignment deliberately mirrors the eight sections above.

The case: ClauseGuard

A computer-science research group at your university has developed a machine-learning system that automatically reads legal contracts and flags risky, missing, or non-standard clauses work that today consumes expensive lawyer hours. The technology has been validated on a benchmark dataset and described in a peer-reviewed paper. The lead researcher, Dr. Amir Haddad, wants to commercialise it, and the university’s Technology Transfer Office is willing to support a spin-out. The proposed company, **ClauseGuard**, would sell a B2B SaaS tool to mid-sized law firms and corporate legal departments. Your task is to turn this research idea into an investor-ready startup. (If your programme prefers, you may substitute your own research idea confirm with your facilitator first.)

9.1 The step-by-step process

Complete the following ten steps in order. Each produces a concrete artefact for your final package. Treat the VoltWise examples in this lesson as your model for the depth and tone expected.

Step 1 IP and idea assessment (the TTO gate)

1. Write an invention-disclosure summary: what the technology does, what is novel, and what intellectual property exists (the algorithm, the paper, any data).
2. State how the IP would move from the university to the company (e.g., a licence or assignment) and what stake the TTO might take. Reference the VoltWise 5% TTO stake as a benchmark.

Deliverable: a half-page IP and ownership note.

Step 2 Market validation and customer discovery

3. Define the problem from the perspective of one real user (a named persona, e.g., a contract lawyer).
4. Identify your Ideal Customer Profile and at least two buyer personas (user, economic buyer).
5. List five customer-discovery questions you would ask to validate the pain.

Deliverable: a one-page problem-and-customer brief.

Step 3 Business model

6. Summarise how ClauseGuard creates, delivers, and captures value (you may use a one-page Business Model Canvas).
7. State your pricing hypothesis and the annual contract value you expect.

Deliverable: a one-page business model summary.

Step 4 MVP definition

8. Describe the minimum version of ClauseGuard that would let a real law firm test the core value (clause-risk flagging) and explicitly list what you would leave out.
9. State the one metric that would prove the MVP works.

Deliverable: a short MVP scope statement.

Step 5 Capital structure and cap table

10. Propose a founder equity split (and the TTO stake), all on a four-year / one-year-cliff vesting schedule.
11. Build a simple cap table at incorporation, after a 12% option pool, and after an angel round taking 15%. Show resulting founder percentages.

Deliverable: a one-page cap table with a two-sentence commentary on dilution.

Step 6 Go-to-market strategy

12. Define your beachhead segment and the sales motion that fits your ACV (use the heuristic from Section 5).
13. Complete a GTM table: segment × channel × pricing × key metric.

Deliverable: a one-page GTM plan including the table.

Step 7 Regulatory and compliance check

14. Identify the standards and regulations that apply to a legal-tech SaaS handling sensitive client documents (consider ISO 27001 and data-privacy law).
15. State which item is most likely to block an enterprise sale and when you must address it.

Deliverable: a short compliance-stack note.

Step 8 Growth roadmap and funding milestones

16. Build a milestone ladder for your next two funding stages: amount raised, milestones bought, and KPIs reported.
17. Identify your single most important KPI for the first 12 months.

Deliverable: a one-page milestone-and-KPI roadmap.

Step 9 Pitch narrative and deck

18. Write the 60-second cold-open story and the origin story (Section 3).
19. Produce a 12-slide deck outline (Section 4), with the traction and ask slides drafted in full.

Deliverable: a one-page narrative plus a 12-slide deck outline.

Step 10 Exit thesis

20. State your most likely exit path, name three realistic acquirers, and list the three assets you must build now to be attractive at exit.

Deliverable: a short exit-thesis paragraph.

9.2 Final submission

Assemble the ten artefacts into a single “ClauseGuard Investor-Readiness Package” (8–12 pages). Add a one-paragraph reflection on the single biggest risk to the venture and how you would address it. Submit through Moodle as one PDF or document. Teams should also prepare a 5-minute live pitch using their Step 9 deck outline.

9.3 Assessment rubric

Criterion	Weight	What excellent looks like
IP, business model & MVP clarity (Steps 1–4)	25%	Clear novelty, sharp ICP, realistic MVP scope
Capital structure & financial logic (Step 5)	15%	Correct cap table; dilution understood
GTM & compliance realism (Steps 6–7)	20%	Motion fits price; compliance risks identified
Growth roadmap & KPIs (Step 8)	15%	Milestones tied to funding and KPIs
Pitch & storytelling (Step 9)	15%	Human story; deck front-loads clarity & traction
Exit thesis & overall coherence (Step 10)	10%	Realistic path; package hangs together

Total: 100%. Facilitators may weight the live pitch separately.

Facilitator notes

- Allow 1–2 weeks for the assignment; the ten steps can be released as Moodle sub-tasks with individual deadlines.
- Encourage peer review between Steps 5 and 9 cap tables and decks improve enormously with a second pair of eyes.
- Remind participants that “realistic and defensible” beats “impressive and invented.” Investors reward honest numbers.

Key Takeaways

1. Match the money to the stage. Angels are fast, early, and lighter; VCs are larger, later, and more formal. Non-dilutive grants and revenue are often the smartest first money for research spin-outs.
2. Protect the cap table. Founder vesting, a clean cap table, and a deliberate option pool keep the company fundable and the founders aligned.
3. Investors fund stories and traction. Lead with a human problem, prove it works, and earn the ask.
4. GTM is a discipline, not an afterthought. Pick a beachhead, match your sales motion to your price, and expand only once one motion works.
5. Compliance is a growth asset. The right standards open markets and build investor trust plan them early.
6. Tie funding to milestones and KPIs. Each round should buy measurable progress toward the next.
7. Plan the endgame. Most exits are acquisitions; build to be valuable to a realistic set of acquirers, and keep the company exit-ready.

Practical Assignment (Chapter 3)

How to Use This Case Study

This case study is the practical capstone of the From Research to Startup curriculum. It is designed to be solved in sequence: each part picks up where the previous part stops, so by the end of the case a single research idea AquaPulse has travelled the full path from a university lab to an investor-ready, growth-planning company. The three parts of the case map directly onto the three lessons in the curriculum.

The case at a glance

Origin: A five-year, EU-funded research project at the Faculty of Environmental Engineering, University of Northern Europe (UNE).

Technology: A low-cost waterproof IoT sensor module plus a cloud AI model that predicts contamination events in rivers and water-treatment intakes 6–24 hours in advance, with 92% accuracy in peer-reviewed pilots.

Team: Dr. Selma Berisha (lead researcher, environmental engineer), Dr. Idris Chen (data scientist), Lucas Mårten (recent MSc, software).

Context: The university's Technology Transfer Hub, TTH-North, is willing to support a spin-out.

Mapping the case to the three lessons

Part	Curriculum lesson	What participants do
Part I	Lesson 1 Ideation to Business Model Engineering	Convert the research result into a market opportunity; pick a tech-transfer pathway; design the business model; plan customer discovery.
Part II	Lesson 2 Incubation Protocols and MVP	Enter incubation; pick an MVP form; prioritise features; use AI/Vibe Coding to ship a prototype; build a Valley-of-Death funding plan.
Part III	Lesson 3 Investor Readiness, Market Strategy, Growth Planning	Build a cap table; write the pitch; design GTM; map compliance; plan funding milestones; write an exit thesis.

How to work through this case

- Read the case background once, end to end, before answering any questions.
- Work the three parts in order each part assumes you have solved the previous one.
- Use the frameworks taught in the corresponding lesson; do not invent new ones.
- After your own attempt, compare with the solved version at the end of the document.
- Teams: assign a different part-lead per part, then integrate during the final deliverable.

Learning outcomes

By the end of this case study, participants will be able to:

13. Choose and justify a technology-transfer pathway for a research-based innovation.
14. Build a Business Model Canvas for a deep-tech venture, with explicit assumptions.

15. Match an MVP approach (full, simulation-based or consulting-based) to the stage and resources of the venture.
16. Apply AI tools and Vibe Coding inside a Build-Measure-Learn loop.
17. Design a funding plan that survives the Valley of Death.
18. Construct a clean cap table and investor narrative for a seed-stage company.
19. Map regulatory and quality standards relevant to a deep-tech SaaS-plus-hardware product.
20. Link funding rounds to milestones and KPIs and articulate a realistic exit thesis.

Case Background Meet AquaPulse

The research origin

For five years, Dr. Selma Berisha has led a research group at UNE focused on real-time monitoring of freshwater quality. Funded through two EU Horizon grants and one national innovation programme, the group set out to answer a deceptively simple question: can we predict pollution events in rivers before they reach drinking-water intakes, so utilities can react in hours instead of days?

The team built two things in parallel. First, a low-cost waterproof sensor module about the size of a smartphone measuring turbidity, dissolved oxygen, conductivity, pH, and ammonia, sampling every 30 seconds and transmitting via cellular network. Second, a machine-learning model that, when fed by a network of these sensors, anticipates spikes in contamination 6 to 24 hours in advance. A peer-reviewed paper, published last year, reported 92% prediction accuracy on two pilot rivers covering 380 km. Local water utilities took notice.

The team

Person	Background	Role
Dr. Selma Berisha	PhD in environmental engineering; lead researcher and project PI	Founder & CEO candidate
Dr. Idris Chen	PhD in computer science; built and maintains the AI prediction model	Co-founder, CTO candidate
Lucas Mårten	MSc in software engineering; built the dashboard and sensor firmware	Co-founder, Head of Engineering
TTH-North (the TTO)	The university's Technology Transfer Hub; owns institutional IP rights	Institutional partner & equity holder

The current situation

It is the start of 2026. The two EU grants have ended. The team has six months of remaining university salary cover, a working sensor design that has been deployed in 14 demonstration units across two rivers, and a software dashboard used internally. Three water utilities (one of them international) have informally indicated they would consider paying for the predictions. TTH-North has invited the team to enter its pre-incubation programme.

The team has decisions to make and decisions that they can no longer postpone. The opportunity is real, but the path is not yet chosen. That is where the case picks up.

Part I Ideation and Business Model

Aligned with *Lesson 1 Ideation to Business Model Engineering*.

Situation

TTH-North gives the team a four-week window before entering pre-incubation, to decide three things: (1) how the technology will leave the university (the tech-transfer pathway); (2) who the first paying customer really is (market pull vs. technology push); and (3) what the business model looks like. The hub's manager, Ms. Erina Vlora, is direct: "We will only host you in pre-incubation if you arrive with explicit assumptions you intend to test, not with a finished story you cannot prove."

The team's working notebook contains the following early signals:

- Eight informal interviews with water-utility operations managers six confirmed that contamination response times are a serious problem; two said current sensor systems are "good enough."
- One major international utility, Hydraulix, has asked whether the team could deliver a paid pilot in the next year.
- A regional sensor manufacturer, Sondex AG, has offered to license the sensor design for a one-off €120,000 upfront fee plus a 3% royalty.
- A consortium of three municipal utilities has proposed a 24-month collaborative R&D contract worth €600,000.
- The team itself is split: Berisha wants the spin-out; Chen worries about losing research time; Mårten is excited but cautious about salary.

Questions Part I

Use the frameworks from Lesson 1 to answer the following.

Q1. Tech-transfer pathway

Three pathways are on the table: (a) licensing to Sondex AG; (b) spin-out as AquaPulse; (c) collaborative R&D with the municipal consortium. Which pathway should the team choose, and why? Write a one-paragraph justification that explicitly addresses fit with the team's ambition, the maturity of the technology, and the size of the opportunity.

Q2. Market pull vs. technology push

Identify two market-pull signals and two technology-push signals visible in the case. Then state, in one sentence, where AquaPulse currently sits on the spectrum.

Q3. Assumption hierarchy

Following the Lean Startup assumption-hierarchy logic for deep tech, list the top five riskiest assumptions AquaPulse must test, ranked from highest to lowest risk. For each, write one sentence describing the cheapest experiment that could falsify it.

Q4. Customer discovery plan

AquaPulse has done 8 interviews. The team needs to scale to roughly 100, applying Lesson 1's customer-discovery rule. Define: (a) two distinct customer segments to interview; (b) the goal of the first 30 interviews; (c) one quantitative threshold that would constitute a "validated" problem signal; (d) one signal that would force a pivot.

Q5. Business Model Canvas

Sketch a Business Model Canvas for AquaPulse at this stage. Fill all nine boxes in short bullet form. Flag the two boxes you are least sure about those are your primary research targets in pre-incubation.

Q6. Deep-tech value proposition

Using the deep-tech value-proposition formula from Lesson 1, write a single-sentence value proposition for AquaPulse in the form: "For [customer], who [problem], AquaPulse delivers [benefit] through [unique mechanism], unlike [alternative]."

Q7. TRL and funding plan

State the current Technology Readiness Level (TRL) of AquaPulse, the target TRL for the next 12 months, and a funding mix (at least three sources) that gets the team from one to the other. Justify why each source fits this stage.

Part II Incubation and MVP

Aligned with *Lesson 2 Incubation Protocols and Minimum Viable Product (MVP)*.

Situation

AquaPulse is admitted to TTH-North's pre-incubation programme in March 2026. The hub provides shared office space, legal support for the spin-out registration, mentorship, and access to a €60,000 proof-of-concept grant. The team has 14 months of effective runway, counting the grant and the founders' time.

Three MVP options are on the table for the next six months:

- Full hardware deployment: install 80 sensors along a target river and run the live AI dashboard for one paying utility. Estimated cost €110,000 + 4 months. High signal but blows the budget and the timeline.
- Simulation-based MVP: use historical data from public river-monitoring stations to drive a digital twin of the AI model, plus a polished dashboard. Estimated cost €25,000 + 6 weeks. Low cost but technical credibility risk with utility buyers.
- Consulting-based MVP: sell a manual "contamination early-warning report" service to two utilities, delivered weekly by the team using available data and the model. Estimated cost €15,000 + 3 weeks. Generates revenue but does not test the productised software.

In parallel, Mårten proposes using Vibe Coding with an AI assistant to ship the dashboard in roughly four weeks instead of three months but Berisha worries about code quality and security for sensor data. Hydraulix, the international utility, has formally committed to a paid pilot at €40,000 if AquaPulse can demonstrate live predictions within six months.

Questions Part II

Use the frameworks from Lesson 2 to answer the following.

Q8. Incubation phase fit and graduation criteria

Which of the three incubation phases (pre-incubation, incubation, acceleration) is the right fit for AquaPulse right now? State three concrete criteria the team must meet to graduate to the next phase.

Q9. MVP form: choose and combine

Evaluate the three MVP options on speed, cost, learning value and customer credibility. Recommend one or a combination for the next six months, with a one-paragraph justification. Reference the Hydraulix commitment and the €60,000 grant constraint.

Q10. Feature prioritisation

Given limited resources, list the five MVP features you would build first. For each, score Value (1–5) and Technical Risk (1–5), and explain why the highest Value × lowest Risk feature must be built first.

Q11. AI / Vibe Coding sprint plan

Mårten's vibe-coding proposal needs structure. Lay out a four-week sprint plan that uses AI tools to ship the dashboard MVP, while addressing Berisha's concerns about code quality and security. Identify the two responsibilities that must remain with a human, not the AI.

Q12. Valley-of-Death funding plan

Design a 12-month funding plan that combines at least four sources (non-dilutive, bridge, revenue, equity) to keep the company alive between pre-incubation and a seed round. Estimate the total raised and the implied runway.

Q13. MVP success criteria

Define three quantitative criteria that would let the team say, with confidence, that the MVP has "succeeded" by the end of the six-month window and is ready to enter incubation proper.

Part III Investor Readiness, GTM and Growth

Aligned with *Lesson 3 Investor Readiness, Market Strategy & Growth Planning*.

Situation

It is October 2026. The MVP succeeded. AquaPulse has three paying pilot customers (two utilities and one bottling plant), €18,000 in monthly recurring revenue from subscription contracts (plus the €40,000 Hydraulix pilot), and is generating predictions that have already prevented two pollution incidents. TTH-North has graduated the team to its acceleration phase. The company is incorporated, the IP is licensed in from the university, and the founders are ready to raise an angel round to reach Series-A readiness in 18 months.

The numbers and decisions on the table:

- Founder equity at incorporation: Berisha 50%, Chen 30%, Mårten 15%, TTH-North 5% all founders on a 4-year vesting schedule with a 1-year cliff.
- The team plans to raise a €500,000 angel round at a €4M post-money valuation, and to set up a 12% option pool before the raise (i.e., pre-money).

- Hydraulix has indicated it would extend its pilot to a €120,000 annual subscription and would consider acting as a reference customer.
- AquaPulse already collects operational data on behalf of EU water utilities bringing GDPR and likely NIS2 obligations into scope.
- Two trade buyers in the water-utility ecosystem have made informal early enquiries.

Questions Part III

Use the frameworks from Lesson 3 to answer the following.

Q14. Capital structure and cap table

Build a simple cap table for AquaPulse at three moments: (a) at incorporation; (b) after a 12% option pool is created pre-money; (c) after the €500,000 angel round at €4M post-money. Show each shareholder's percentage at each moment and state, in one sentence, what the founders give up in this round and what they gain.

Q15. Pitch narrative and deck outline

Write the 60-second cold-open story for the AquaPulse pitch. Then produce a 12-slide deck outline, with the traction and ask slides drafted in detail (real numbers from the case).

Q16. Go-to-market strategy

Define: (a) the ideal customer profile (ICP) and a named beachhead segment; (b) the sales motion that fits, using the ACV heuristic from Lesson 3; (c) the pricing model; (d) two channels you would prioritise. State one segment you will explicitly NOT pursue in the next 12 months.

Q17. Regulatory and quality stack

Map the compliance "stack" applicable to AquaPulse, from foundational to sector-specific. Identify the single item most likely to block an enterprise sale if ignored, and the one most likely to unlock new markets if achieved early.

Q18. Funding milestones and KPIs

Design a milestone ladder for the next two funding stages (the angel round you are raising now, then the Series A 18 months later). For each, state the amount, the milestones the money buys, the 2–3 KPIs you will report, and the headline KPI for the first 12 months.

Q19. Exit thesis

Write a short exit thesis for AquaPulse: the most likely path; three realistic acquirers (with a one-line reason for each); and the three assets you must build now to be attractive at exit.

Q20. Risk register and final integration

List the top three strategic risks AquaPulse faces today (across technology, market and team) and, for each, the mitigation built into your earlier answers. Then write one paragraph that ties the journey from Part I to Part III into a single sentence-per-part narrative for an investor.

Final Integration Deliverable

Combine your answers into a single five-page "AquaPulse Investment Memo" with the following structure:

21. Executive summary (one paragraph).
22. Tech-transfer pathway, business model, value proposition (Part I).
23. Incubation status, MVP and funding plan (Part II).
24. Cap table, GTM, compliance, milestone ladder, exit thesis (Part III).
25. Risk register and 12-month roadmap.

Teams should additionally prepare a 5-minute pitch using the Part III deck outline.

Solved Case Study Model Answers

The following solutions are deliberately specific. They are not the only valid answers, but each illustrates the depth, framework use and concrete reasoning that participants should aim for.

Part I Ideation and business model

A1. Tech-transfer pathway

Recommendation: spin-out as AquaPulse, with a non-exclusive licence-out option to Sondex AG kept on the table as a fallback.

Licensing to Sondex captures only the sensor hardware (a small fraction of the value) and disconnects the team from the AI model, which is the defensible asset. Collaborative R&D with the municipal consortium pays the bills but locks the team into a service relationship without product equity. The spin-out path matches the team's ambition (Berisha explicitly wants it), the technology maturity (a validated prototype with utility interest), and the size of the opportunity (a paying international customer is already asking). The spin-out also preserves the option to license the sensor hardware later, while keeping the AI software and customer relationships inside the company. This is the path that maximises long-term value.

A2. Market pull vs. technology push

Market-pull signals: (1) six out of eight interviewed operations managers confirmed contamination response is a serious problem; (2) Hydraulix has explicitly asked for a paid pilot.

Technology-push signals: (1) the sensor was designed because the technology was feasible, before customer segments were defined; (2) the team is still split internally about who the right first customer is. **Position:** AquaPulse is currently mid-spectrum, leaning technology-push, and must deliberately tilt toward market pull in pre-incubation by completing customer discovery before committing to a deployment architecture.

A3. Assumption hierarchy (highest → lowest risk)

26. Utilities will pay for predictions, not just data. Experiment: a 30-minute pricing conversation with 10 operations managers, asking what they would pay per protected intake.
27. The AI model generalises beyond the two pilot rivers. Experiment: re-run the model on three public datasets from other river basins and report accuracy.
28. Sensor maintenance cost stays below 15% of subscription revenue. Experiment: collect 90 days of maintenance logs from the existing 14 demo units and extrapolate.
29. A 6–24-hour warning is operationally actionable. Experiment: shadow one utility's response team and confirm what actions become possible at each warning horizon.
30. The economic buyer is the operations director, not procurement. Experiment: ask in the next ten interviews who, by name, would sign a €40K contract.

A4. Customer discovery plan

- **Segments:** (i) municipal drinking-water utilities (slow buyers, high credibility); (ii) industrial water users (food/beverage, energy) (faster buyers, smaller deals).
- **Goal of the first 30 interviews:** test whether the contamination-response problem is real, painful and quantifiable not yet validate willingness to pay.
- **Validated problem signal:** $\geq 70\%$ of interviewees describe the problem unprompted as a top-five operational risk and can name the cost of a missed event.
- **Pivot signal:** if fewer than 30% of interviewees confirm the pain point, AquaPulse must pivot the customer segment most likely toward industrial water users.

A5. Business Model Canvas (sketch)

Box	Content	Confidence
Customer segments	EU municipal water utilities (beachhead); industrial water users (expansion)	Medium
Value proposition	Prevent contamination incidents with 6–24 h advance prediction at $<15\%$ of incident cost	Medium
Channels	Direct sales + partnerships with water-association events	Low to test
Customer relationships	Annual subscription + integration support; named customer success manager	Medium
Revenue streams	Subscription per protected intake ($\sim\text{€}40\text{K}–\text{€}120\text{K}/\text{yr}$) + setup fee	Low to test
Key activities	AI model improvement, sensor deployment, customer success	High
Key resources	Sensor design, AI model, data partnerships, team	High
Key partners	TTH-North, sensor manufacturer, EU water associations, system integrators	Medium
Cost structure	R&D, sensor manufacturing, cloud hosting, sales, compliance (ISO 27001 / GDPR)	Medium

Primary research targets in pre-incubation: Channels and Revenue streams these are the two boxes with the lowest current confidence.

A6. Deep-tech value proposition

"For European water utilities, who suffer hours of blind response time during contamination events, AquaPulse delivers reliable 6-to-24-hour advance warnings through a network of low-cost sensors and an AI model trained on real river dynamics, unlike traditional spot-sampling or downstream alarms."

A7. TRL and funding plan

Current TRL: 5 (technology validated in relevant environment two pilot rivers). **Target TRL in 12 months:** 7 (system prototype demonstrated in an operational environment with a paying utility). **Funding mix:** (a) TTH-North proof-of-concept grant $\text{€}60,000$, non-dilutive, fits because at TRL 5 risk is still technical; (b) the $\text{€}40,000$ Hydraulix paid pilot customer-funded, validates demand; (c) a national innovation voucher $\text{€}30,000$, non-dilutive, finances ISO-27001 readiness work; (d) founders' own time and salary forbearance equity-aligned. Equity raises are deliberately deferred until TRL 6+ to avoid pricing the company too early.

Part II Incubation and MVP

A8. Incubation phase fit and graduation criteria

Pre-incubation is the right fit. The team has a research result and early signals but no validated business model and no productised MVP. Graduation criteria to incubation proper: (1) a working MVP with at least one signed paying pilot customer (Hydraulix); (2) a registered company with the IP licence in place; (3) a credible 12-month financial forecast with at least nine months of runway secured.

A9. MVP form: choose and combine

Recommendation: a combination consulting-based MVP for the first six weeks, layered with a simulation-based dashboard from week 4, and a small live deployment only at the Hydraulix site by month 5.

The consulting MVP starts revenue and learning immediately (the team already has the expertise and the data), validating willingness to pay without burning the grant. The simulation MVP, built in parallel using AI/vibe coding, gives prospects (including Hydraulix) something tangible to evaluate, at low cost. A scaled-back live deployment at Hydraulix (~15 sensors, not 80) costs roughly €35,000 within budget and satisfies the six-month commitment. This sequence respects the €60K grant, hits the Hydraulix deadline, and produces both revenue and learning in parallel. The pure full-hardware option is rejected as too expensive and slow; the pure simulation option is rejected because it does not test the productised hardware on a paying customer.

A10. Feature prioritisation

#	Feature	Value	Risk	Value × (6 – Risk)
1	AI contamination-prediction engine (core)	5	3	15
2	Operator dashboard with alert thresholds	5	2	20
3	Sensor-to-cloud data pipeline	4	3	12
4	Email/SMS alerts to operations team	4	1	20
5	Historical reporting / audit log (compliance)	3	2	12

The operator dashboard and the alert pipeline are the highest scoring (highest value × lowest technical risk) they must be built first because, without them, the AI engine cannot reach the operator who needs the prediction.

A11. AI / Vibe Coding four-week sprint

Week	Focus	AI tool use	Human-only checkpoint
1	One-page MVP brief + 3 user actions; UI sketches	AI assistant generates UI scaffolding	Founders sign off on brief
2	Dashboard front-end + connection to simulated AI feed	Code assistant builds React components	Architect reviews data-flow diagram
3	Alert pipeline + audit log + basic auth	AI generates boilerplate + tests	Security review of auth & secrets
4	User testing with two utility operators; iterate	AI summarises feedback into next-sprint backlog	Founders pick what ships v1.0

Two responsibilities that stay with humans: (1) security and data-handling review never delegated to the AI assistant; (2) the product decision about what ships, based on user feedback, which is a judgment call about strategy and risk, not a technical one.

A12. Valley-of-Death funding plan (12 months)

Source	Type	Amount	Why it fits
TTH-North PoC grant	Non-dilutive	€60,000	Already secured; covers MVP build
Hydraulix paid pilot	Customer revenue	€40,000	Validates demand and pays for live deployment
National innovation voucher	Non-dilutive	€30,000	Co-funds ISO 27001 readiness
Two additional pilot subscriptions	Customer revenue	€60,000	Two utilities × €30K six-month pilots
Founders' salary forbearance	Equity-aligned	€40,000 (in kind)	Preserves cash for build & sales
Bridge convertible note from one angel	Convertible	€100,000	Optional, only if needed at month 9

Total raised: ~€330,000 (cash, excluding salary forbearance). At a burn of roughly €22K/month after grants and revenue, this yields ~14–15 months of runway and crosses the Valley of Death into the planned seed round.

A13. MVP success criteria (end of month 6)

31. At least one paying contract signed (Hydraulix at €40K) and at least two more paid pilots underway.
32. AI model accuracy $\geq 85\%$ on a new river basin not used in training proving generalisation.
33. Dashboard in daily use by $\geq 70\%$ of paying-customer operators (active-user metric), with one customer testimonial usable in the pitch deck.

Part III Investor readiness, GTM and growth

A14. Cap table at three moments

Shareholder	(a) At incorporation	(b) After 12% pool	(c) After €500K angel
Dr. Selma Berisha	50.00%	44.00%	38.50%
Dr. Idris Chen	30.00%	26.40%	23.10%
Lucas Mårten	15.00%	13.20%	11.55%
TTH-North (TTO)	5.00%	4.40%	3.85%
Option pool (unallocated)	0.00%	12.00%	10.50%
Angel investors	0.00%	0.00%	12.50%
Total	100.00%	100.00%	100.00%

Note: The €500K angel round at €4M post-money implies the angels take $€500K \div €4M = 12.5\%$. The 12% option pool is created pre-money, so it dilutes all existing shareholders before the angel investment lands.

What founders give up and gain: the founders' combined stake falls from 95% to ~73%, but in exchange they receive €500K of fuel, an experienced angel network, the ability to hire (via the option pool) and credibility for the Series A.

A15. Pitch narrative and deck outline

60-second cold-open: "Meet Ana, the operations director of a mid-sized water utility. Last summer a pollution plume reached her intake at 3 a.m. Her team learned about it from a complaint at 7 a.m. four hours after the water was already in the distribution network. Notifying 80,000 households cost the utility more than the entire annual cost of monitoring all its rivers. AquaPulse exists so that Ana

finds out about that pollution event six to twenty-four hours before it reaches her intake. Built by environmental engineers who spent five years measuring exactly this gap, we have already prevented two incidents at Hydraulix."

#	Slide	What it says (AquaPulse specifics)
1	Cover / one-liner	AquaPulse six to twenty-four hours before pollution reaches the intake
2	Problem	Utilities respond hours after contamination; cost is high, response is reactive
3	Solution	IoT sensor network + AI prediction engine, peer-reviewed at 92% accuracy
4	Product / demo	Live dashboard screenshot, alert flow, sensor photo
5	Market size (bottom-up)	~14,000 EU water utilities × €40–€120K ACV ≈ €1.1B SAM
6	Business model	Annual subscription per protected intake + setup fee
7	Traction ★	3 paying pilots; €18K MRR (+ €40K Hydraulix); 2 incidents prevented; 96% retention
8	Go-to-market	Beachhead: EU mid-size municipal utilities; direct sales + water-association partners
9	Competition	Spot-sampling (manual), telemetry-only sensor co's (no AI), big utilities IT (no domain model)
10	Team	Two PhDs + engineer; 5-year research history; named TTO partner
11	Financials	Path to €1M ARR in 18 months at LTV:CAC > 4:1
12	The Ask ★	Raising €500K to reach 10 paying utilities, ISO 27001 certification and Series-A readiness in 18 months

A16. Go-to-market strategy

- **ICP:** EU municipal drinking-water utilities serving 50,000–250,000 inhabitants, with at least one surface-water intake. Beachhead: that ICP within three target countries where AquaPulse already has reference customers or partnerships.
- **Sales motion:** with an ACV of €40K–€120K, this sits in the demand-generation + inside-sales band of Lesson 3's heuristic. A small inside-sales function (1 FTE plus the CEO) supported by content marketing and water-association events.
- **Pricing:** subscription per protected intake (~€40K/yr starting tier; tiered up to €120K/yr) plus a one-off €10K setup fee that covers sensor deployment and onboarding.
- **Two priority channels:** (1) direct outbound to operations directors at named target utilities; (2) co-marketing with EurEau and national water associations.
- **Explicitly not pursuing in the next 12 months:** very large national utilities long sales cycles, complex procurement, distract from the beachhead.

A17. Regulatory and quality stack

Layer	Standard / regulation	Status for AquaPulse
Foundational QMS	ISO 9001	Optional now; useful signal at growth
Information security	ISO 27001 + SOC 2 readiness	Critical start in seed round
Data privacy	GDPR (and NIS2 once in force)	Mandatory operational data in scope
Sector regulation	EU Drinking Water Directive (2020/2184); national water-quality rules	Indirect AquaPulse supports utility compliance

Sensor calibration	ISO/IEC 17025 (lab calibration) for sensor reference data	Important for credibility & legal defensibility
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Most likely to block a sale if ignored: ISO 27001 readiness large EU utilities' procurement teams require security assurances before signing. **Most likely to unlock new markets if achieved early:** ISO 27001 certification combined with documented alignment to the EU Drinking Water Directive together they make AquaPulse a buy-don't-build choice for utilities outside the original three target countries.

A18. Funding milestones and KPIs

Stage	Amount	Milestones it buys	KPIs reported
Angel (now)	€500K at €4M post	10 paying utilities; ISO 27001 ready; €1M ARR run-rate	MRR/ARR growth, CAC, LTV:CAC, retention
Series A (in ~18 months)	€4–6M	30+ utilities; 3 country expansion; €4M ARR	Net revenue retention, CAC payback, sales cycle, gross margin

Headline KPI for the first 12 months: Paying utilities (count) the metric that most directly proves repeatability and underpins the ARR figure.

A19. Exit thesis

Most likely path: acquisition by a strategic acquirer in the water-utility or environmental-monitoring ecosystem, in roughly 5–7 years.

Realistic acquirer	Why they would buy
A large water-utility conglomerate (e.g., Veolia, Suez)	Adds a high-margin software product to a low-margin services business; opens cross-sell to thousands of utilities
An environmental-sensor incumbent (e.g., Hach, Endress+Hauser)	Adds AI-based prediction to its hardware franchise; defends against software-led entrants
An industrial-IoT platform (e.g., Siemens, Schneider)	Strengthens vertical depth in water; complements smart-city plays

Three assets to build now to be attractive at exit: (1) defensible IP extend the AI model and own the proprietary training data; (2) reference customer base named EU utilities act as social proof; (3) ISO 27001 + GDPR compliance removes due-diligence friction and protects price.

A20. Risk register and final integration

#	Risk	Where mitigated in this case
1	Technology: the AI model does not generalise outside the two pilot rivers (Part I assumption #2)	Part II's MVP plan explicitly tests on a new basin; Part III's ISO 17025 calibration item underpins generalisation
2	Market: utilities buy slowly through procurement, killing runway	Part II's funding plan combines non-dilutive + revenue + bridge; Part III's beachhead focus shortens cycles
3	Team: Chen's research-time concern leads to disengagement	Part I's spin-out decision retains co-founder roles; Part III's option pool gives clear equity upside

One-sentence investor narrative across the three parts:

Part I a five-year university research project produced a peer-reviewed, 92%-accurate contamination prediction engine for water utilities. **Part II** over six months in pre-incubation, AquaPulse converted that research into a paid Hydraulix pilot, a working AI-built dashboard, and a Valley-of-Death funding mix that bought 15 months of runway. **Part III** with three paying pilots and €18K MRR, the company is raising €500K from angels to reach ten paying utilities, ISO 27001 certification and €1M ARR the asset base for a Series A in 18 months and, in time, an acquisition by a water or industrial-IoT incumbent.

Summary and Conclusion

The **Tech2Link Technology Transfer & Innovation Handbook** brings together a comprehensive learning pathway designed to strengthen the knowledge, practical skills and decision-making capabilities required to support technology transfer and innovation. Across its three courses, the handbook follows the journey from **research and intellectual property, through measurement and evaluation, to commercialization and startup creation**.

The central idea connecting the entire handbook is that technology transfer is not a single transaction or administrative activity. It is a process through which knowledge, research results and innovation are transformed into practical, economic and societal value. Successful transfer requires the coordinated contribution of researchers, universities, Technology Transfer Offices, companies, investors, governments, innovation hubs and other ecosystem actors.

From Research to Real-World Impact

The first course establishes the foundations for understanding what is being transferred and how innovation can be protected. Intellectual property including patents, copyright, trademarks, trade secrets and know-how provides important mechanisms for managing innovation. At the same time, intellectual property cannot be considered separately from ownership, disclosure, contractual arrangements, commercialization objectives and the broader innovation ecosystem.

The handbook emphasizes that effective IP management is **strategic rather than purely legal**. Protecting an invention is only one part of the process. Researchers and institutions must also understand ownership, prior art, Freedom-to-Operate, contractual relationships and the potential pathways through which an innovation can reach users and markets.

The role of the Technology Transfer Office is particularly important in connecting these dimensions. TTOs can help identify promising research results, support IP protection, facilitate partnerships, manage commercialization processes and connect researchers with industry, investors and other ecosystem actors.

Measuring What Matters

The second course adds a critical dimension: **measurement**.

Technology transfer cannot be managed effectively without evidence of performance and value. However, the handbook makes an important distinction between collecting data and measuring what actually matters.

Indicators should support decisions. They should help institutions understand whether technology-transfer activities are progressing, where resources are being used, which activities generate value and where intervention may be required. The handbook therefore addresses institutional and economic KPIs, leading and lagging indicators, commercialization pipelines, benchmarking, ecosystem assessment and Social Return on Investment.

Value should also be understood from multiple perspectives. Financial returns may be important, but technology transfer can additionally generate employment, industrial development, new research partnerships, improved public services, environmental benefits and other forms of societal impact.

This broader perspective is essential for universities and innovation hubs whose contribution cannot always be captured through immediate financial revenue.

From Measurement to Commercialization

The third course moves from understanding and measuring technology transfer toward **action and commercialization**.

Commercialization is not a one-size-fits-all process. Different technologies require different strategies. Depending on the technology, market, investment requirements and development stage, an institution may consider exclusive or non-exclusive licensing, strategic partnerships, or the creation of a startup or university spin-off.

The handbook therefore addresses licensing structures, royalties, milestones, sublicensing, equity, negotiation, Freedom-to-Operate, Technology Readiness Levels, startup creation and innovation-hub support.

The underlying principle is that commercialization decisions should be based on evidence and strategic fit. A technically promising technology may still require substantial market validation, additional investment, regulatory approval, industrial partnerships or further development before commercialization becomes viable.

The Innovation Ecosystem

One of the strongest themes running throughout the handbook is the importance of **ecosystems**.

Universities cannot transfer technology effectively in isolation. Innovation emerges through relationships between universities, researchers, industry, government, investors, Technology Transfer Offices, incubators, accelerators and other support organizations.

Strong ecosystems can improve access to funding, accelerate commercialization, create partnership opportunities and support internationalization. At the same time, ecosystems can face challenges such as unequal access to funding, regional innovation disparities, bureaucracy, weak collaboration cultures and limited commercialization expertise.

The Triple Helix perspective linking **universities, industry and government** provides an important framework for understanding these relationships.

For the Western Balkans, strengthening such connections is particularly relevant. The Tech2Link project brings together institutions from the Western Balkans and the European Union with the objective of strengthening technology transfer, knowledge exchange and innovation capacity.

Responsible Innovation

Technology transfer must create value responsibly.

Throughout the handbook, legal, ethical, sustainability, privacy, security and inclusion considerations are integrated into the learning process. This is particularly important for emerging technologies such as artificial intelligence, digital health and biotechnology, where commercialization can create both significant opportunities and complex risks.

Responsible innovation means considering these issues early rather than treating them as obstacles that appear only after a technology has reached the market.

The objective is therefore not simply:

Can this technology be commercialized?

It is also:

How can it be commercialized responsibly, sustainably and in a way that creates meaningful value for society?

What Learners Should Take Forward

By completing the three-course learning pathway, learners should have developed a connected set of professional capabilities.

1. Intellectual Property and Ecosystem Literacy

Learners should be able to identify relevant intellectual-property assets, understand basic protection strategies and recognize the roles of the different actors within an innovation ecosystem.

2. Performance Measurement

Learners should be able to design meaningful indicators, interpret KPIs and understand how technology-transfer performance can be evaluated through institutional, economic and societal perspectives.

3. Economic Evaluation

Learners should understand how economic value can be assessed and how tools such as ROI, economic-impact analysis and related evaluation approaches can support investment and commercialization decisions.

4. Legal and Risk Awareness

Learners should be able to recognize important ownership, contractual, regulatory and commercialization risks and understand the importance of addressing them before major commitments are made.

5. Commercialization Capability

Learners should be able to compare licensing, partnership and startup/spin-off pathways and develop recommendations based on technology characteristics, market conditions, scalability, funding requirements and long-term objectives.

6. Strategic Communication

Learners should be able to communicate technology-transfer opportunities and results through structured recommendations, executive briefs, impact narratives and other decision-support formats. These capabilities correspond closely to the expected outcomes defined across the handbook.

Key Messages from the Handbook

The complete learning journey can be summarized through ten central messages:

1. **Protect innovation strategically.** Different intellectual-property assets require different protection and governance approaches.
2. **Think in ecosystems.** Universities, TTOs, industry, investors, government and support organizations are interconnected.
3. **Measure what matters.** KPIs should support decisions rather than simply increase reporting.
4. **Look beyond financial returns.** Technology transfer can generate financial, economic, institutional and societal value.
5. **Use appropriate evaluation methods.** The right financial or economic method depends on the question being asked and the assumptions should be transparent.
6. **Treat contracts as strategic tools.** Agreements help manage ownership, risk, incentives and commercialization relationships.
7. **Recognize that licensing is flexible.** Exclusivity, royalties, milestones, territory and other terms should reflect the technology and market.

8. **Understand Freedom-to-Operate.** Owning or licensing intellectual property does not necessarily eliminate third-party rights or commercialization risks.
9. **Build responsible innovation into the process.** Ethics, sustainability, privacy, security and inclusion should be considered early.
10. **Focus on real-world impact.** Ultimately, technology transfer connects research capability with practical use and measurable value.

From Knowledge to Action

The practical assignments and case studies throughout the handbook reinforce an important lesson: **technology-transfer professionals are decision-makers.**

They must often work with incomplete information, competing stakeholder interests and significant uncertainty. They may need to determine whether an invention should be patented, assess ownership, evaluate commercialization alternatives, identify legal risks, design funding strategies and consider ethical implications all at the same time.

The Smart-Heal AI practical assignment illustrates this integrated approach. Learners are required to consider intellectual property, ownership, commercialization pathways, legal and regulatory risks, funding, ecosystem support and ethics as interconnected elements of one commercialization decision.

This reflects the reality of technology transfer: **the most important decisions rarely belong to only one discipline.**

Legal knowledge must interact with business strategy. Technical knowledge must interact with market understanding. Financial evaluation must interact with societal impact. Research excellence must interact with entrepreneurial capability.

The completion of this handbook should therefore not be viewed as the end of the learning process.

Technology transfer is continuously changing. New technologies, markets, regulatory frameworks, financing models and forms of collaboration will continue to create new opportunities and new challenges. Professionals working in this field must therefore continue to learn, adapt, measure outcomes and build relationships across institutional and sectoral boundaries.

The strongest innovation ecosystems are not those that simply produce the largest number of patents, startups or agreements. They are ecosystems capable of **turning knowledge into sustainable outcomes.**

The Tech2Link learning pathway provides a foundation for developing that capability. It connects intellectual-property awareness with measurement, measurement with economic and societal value, and commercialization with responsible innovation.

Final Reflection

The journey presented in this handbook can be understood as a continuous chain:

Research → Intellectual Property → Collaboration → Measurement → Evaluation → Commercialization → Entrepreneurship → Impact

Each element strengthens the others.

Without research, there is no knowledge to transfer.

Without appropriate IP and governance, valuable knowledge may not be adequately protected.

Without collaboration, technologies may struggle to reach the people and markets that need them.

Without measurement, institutions cannot understand performance or value.

Without sound evaluation, investment and commercialization decisions become more uncertain. Without commercialization and entrepreneurship, many promising technologies may never reach practical application.

And without responsible innovation, economic success may fail to translate into sustainable societal benefit.

The ultimate purpose of technology transfer is therefore not simply to move technology from one place to another. It is to **build bridges between knowledge and action, between universities and industry, between innovation and investment, and ultimately between research and society.**

This is the central ambition of Tech2Link.

The Tech2Link Handbook has been designed to provide learners with the knowledge, tools and practical perspective needed to participate meaningfully in technology-transfer and innovation ecosystems. Its three courses form an integrated capability-building pathway: the first establishes the foundations, the second provides the evidence and measurement discipline, and the third develops the commercial and entrepreneurial mechanisms required to move innovation toward the market.

The journey from research idea to real-world impact is complex, but it is also an opportunity. Universities and innovation hubs have the potential to become powerful engines of economic development, entrepreneurship, industrial collaboration and societal progress.

The challenge is to build the connections.

The opportunity is to create the value.

The responsibility is to ensure that innovation serves society.

Tech2Link Bridging the Gap between Universities, Business and Society.

References

- European Commission, Joint Research Centre, with ASTP (Campbell et al., 2020). Knowledge and Technology Transfer Metrics input, output and impact indicator framework.
- AUTM. U.S. Licensing Activity Survey (FY2021–FY2022 highlights); and NSF/NCSSES, Science & Engineering Indicators (INV-13), citing AUTM data.
- ASTP. European Annual Survey on Knowledge Transfer; and reporting on cross-jurisdiction differences in metric definitions. astp4kt.eu.
- Etzkowitz, H., & Leydesdorff, L. (2000). The dynamics of innovation: from National Systems and 'Mode 2' to a Triple Helix. *Research Policy*.
- Nicholls, J. et al. (2012). A Guide to Social Return on Investment. (SROI principles and stages.)
- European Commission (2024). European Innovation Scoreboard 2024. Publications Office of the European Union.
- European Commission. Horizon Europe General Annexes Technology Readiness Levels (TRL); TRL scale originally developed by NASA.
- Feldman, M., Colaianni, A., & Liu, C. (2007). Lessons from the Commercialization of the Cohen–Boyer Patents: The Stanford University Licensing Program. (Licensing revenue scale and concentration.)
- AUTM. U.S. Licensing Activity Survey startups, licenses and income aggregates; and the AUTM/BIO economic-contribution studies.
- European Commission, Joint Research Centre, with ASTP (Campbell et al., 2020). Knowledge and Technology Transfer Metrics.
- HM Treasury. The Green Book: appraisal and evaluation in central government standard methods for cost–benefit analysis and discounting.
- European Commission (2024). European Innovation Scoreboard 2024. Publications Office of the European Union.
- KU Leuven Research & Development (LRD). Research figures 2025 (collaboration agreements, patents, license income, spin-offs). research.kuleuven.be.
- ASTP. European Annual Survey on Knowledge Transfer; and reporting on metric-harmonization challenges across European jurisdictions. astp4kt.eu.
- European Commission, Joint Research Centre (Campbell et al., 2020), with ASTP. Knowledge and Technology Transfer Metrics input, output and impact indicator framework.
- Feldman, M., Colaianni, A., & Liu, C. (2007). Lessons from the Commercialization of the Cohen–Boyer Patents: The Stanford University Licensing Program. (Revenue scale and concentration of licensing returns.)
- Kaplan, R. S., & Norton, D. P. (1992). The Balanced Scorecard Measures That Drive Performance. *Harvard Business Review*.
- European Commission (2024). European Innovation Scoreboard 2024. Publications Office of the European Union.
- Blank, S., & Dorf, B. (2020). The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company. K&S Ranch.
- European Commission. (2022). Guiding principles for knowledge valorisation. <https://research-and-innovation.ec.europa.eu/research-area/industrial-research-and-innovation/eu->

valorisation-policy/knowledge-valorisation-platform/guiding-principles-knowledge-valorisation-and-implementing-codes-practice_en

European Commission. (2023). Code of practice on the management of intellectual assets for knowledge valorisation. https://research-and-innovation.ec.europa.eu/research-area/industrial-research-and-innovation/eu-valorisation-policy/knowledge-valorisation-platform/guiding-principles-knowledge-valorisation-and-implementing-codes-practice/code-practice-management-intellectual-assets-knowledge-valorisation_en

European Innovation Council. (2026). EIC Work Programme 2026. <https://eic.ec.europa.eu/>

EIT. (2026). European Institute of Innovation and Technology. <https://www.eit.europa.eu/>

NCP Portal. (2022). TRL self-assessment guidance and Technology Readiness Level support material. <https://horizoneuropencpportal.eu/>

Osterwalder, A., & Pigneur, Y. (2010). Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers. Wiley.

Ries, E. (2011). The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses. Crown Business.

Strategyzer. (2026). The Business Model Canvas. <https://www.strategyzer.com/library/the-business-model-canvas>

The Lean Startup. (n.d.). Lean Startup methodology principles. <https://theleanstartup.com/principles>

VentureWell. (2016). The National Science Foundation Innovation Corps Teaching Handbook. <https://venturewell.org/wp-content/uploads/I-Corps-Teaching-Handbook-Jan16.pdf>

Source materials integrated

Funding Opportunities and Potential Sources of Revenue for Start-ups and Technology Transfer Hubs, Prof. Dr. Adrian Besimi.

Challenges and Pitfalls in Technology Transfer: Lessons from SEEU Experience, Prof. Dr. Adrian Besimi.

Understanding Technology Transfer Ecosystems: EU Focus, Prof. Dr. Adrian Besimi.

Note: Sources are grouped by lesson section. Items marked were drawn from the course reference list; others are additional credible sources used to verify and enrich the material. All URLs were accessible as of May 2026.

Section 1 The Investment Landscape

Stripe. "Angel investors vs. venture capitalists: what founders need to know." Stripe Resources. <https://stripe.com/resources/more/angel-investors-vs-venture-capitalists-what-founders-need-to-know>

Gilion. "Venture Capitalists vs Angel Investors: Key Differences."

Angel Capital Association (ACA). "Raising Angel and Venture Capital Finance" (guide).

PitchDrive. "Angel Investors vs. Venture Capital: Key Differences Explained." <https://www.pitchdrive.com/academy/venture-capital-vs-angel-investors-key-difference-explained>

Section 2 Capital Structure, Equity, and Vesting

Cake Equity. "Founder shares / Founder equity: Everything you need to know." <https://www.cakeequity.com/guides/founder-equity>

Ashfords. “Founder vesting – aligning incentives and safeguarding equity.”

Rho. “Vesting 101: Structuring equity for founders and employees.”

<https://www.rho.co/blog/vesting-for-startups>

Carta. “Founder Shares: Key Characteristics & Structures.”

<https://carta.com/learn/startups/equity-management/founder-shares/>

Section 3 Pitching and Storytelling

Forbes. “How storytelling can help you craft an investor pitch that stands out.”

SeedLegals. “Storytelling for startups: the superpower that wins investors.”

Qubit Capital. “Storytelling for Startups: Create Investor-Winning Pitch Decks.”

<https://qubit.capital/blog/storytelling-techniques-for-pitch-decks>

Section 4 Building an Effective Investor Deck

Slidebean. “Pitch Deck Structure: What Investors Want To See” / “Pitch Deck Examples from 35+ Startups.” <https://slidebean.com/blog/pitch-deck-structure>

Venngage. “30 Startup Investment Pitch Deck Examples (+ Templates).”

Waveup. “Traction Slide: What VCs Look For + Examples.” <https://waveup.com/blog/traction-slide-pitch-deck/>

Qubit Capital. “Pitch Deck Market Size Slide: TAM, SAM & SOM Guide.”

<https://qubit.capital/blog/market-size-slide-pitch-deck>

Section 5 Go-to-Market Strategy

York IE. “How to create a go-to-market strategy for startups.”

Stripe. “What is a go-to-market strategy? A quick GTM guide for startups.”

HubSpot. “What is a Go-to-Market Strategy? GTM Plan Template + Examples.”

<https://blog.hubspot.com/sales/gtm-strategy>

Highspot. “Go-to-market strategy examples and insights (2026).”

<https://www.highspot.com/blog/go-to-market-strategy/>

Section 6 Regulatory Compliance and Quality Standards

U.S. Food and Drug Administration (FDA). “Quality Management System Regulation (QMSR)” and “Current Good Manufacturing Practice (CGMP) Regulations.”

<https://www.fda.gov/medical-devices/postmarket-requirements-devices/quality-management-system-regulation-qmsr>

BSI. “The Role of ISO 13485 Certification in Regulatory Compliance.”

<https://www.bsigroup.com/en-US/products-and-services/standards/iso-13485-quality-management-system/>

SimplerQMS. “ISO 13485: Definition, Requirements, and Certification.”

<https://simplerqms.com/iso-13485-quality-management-system/>

ArisGlobal. “EMA & FDA Alignment on ISO IDMP.”

Section 7 Growth, Scaling, and Funding Milestones

ScienceDirect. “Scaling Wheel Framework” (research overview).

StartupStage. “Scale Your Startup Without Sacrificing Equity.”

Qubit Capital. “Startup Metrics Investors Track: Essential KPIs” and “Series A Funding Explained.” <https://qubit.capital/blog/startup-metrics-investors-track>

Visible.vc. “The Ultimate Guide to Startup Funding Stages.” <https://visible.vc/blog/startup-funding-stages/>

Section 8 Exit Strategies

J.P. Morgan. “Business Exit Strategies for Startup Founders & Entrepreneurs” and “M&A Dominates EMEA Startup Exits as IPOs Hit Decade Low.” <https://www.jpmorgan.com/insights/investing/investment-strategy/business-exit-strategies-for-startup-founders-and-entrepreneurs>

MaRS Discovery District. “Exit strategy planning: IPOs, M&A & licensing.”

Silicon Valley Bank (SVB). “Startup Exit Strategies Other Than an IPO.” <https://www.svb.com/startup-insights/startup-strategy/types-startup-exit-strategy/>

Chemmanur, T. “IPOs or Acquisitions? A Theory of the Choice of Exit Strategy” (academic paper).

Study.com. “Exit Strategies for Startups: Acquisition, IPO & More.”

Appendix

Appendix A. Quick Glossary

Term	Definition
IP	Intellectual Property; legally protectable creations, knowledge and intangible assets.
Patent	An exclusive right granted for an invention that meets applicable legal requirements.
Copyright	Protection for original expression such as software, publications and creative works.
Trademark	A sign that distinguishes goods or services and supports brand identity.
Trade secret	Confidential information with commercial value protected through reasonable secrecy measures.
TTO	Technology Transfer Office; an institutional unit supporting protection, commercialization and partnerships.
KPI	Key Performance Indicator; a defined measure used to monitor performance against objectives.
ROI	Return on Investment; a measure comparing returns with investment cost.
NPV	Net Present Value; the present value of future cash flows less investment cost.
IRR	Internal Rate of Return; the discount rate at which an investment's NPV equals zero.
SROI	Social Return on Investment; a framework for assessing social value relative to investment.
NDA	Non-Disclosure Agreement; a contract governing confidential information.
MTA	Material Transfer Agreement; a contract governing transfer and use of research materials.
JDA	Joint Development Agreement; an agreement governing collaborative technology development.
FTO	Freedom-to-Operate; an assessment of whether commercialization may infringe third-party rights.
TRL	Technology Readiness Level; a scale used to describe technology maturity and readiness.
Spin-off	A company created to commercialize research, technology or know-how originating from an institution.
Licensor	The owner or rights-holder granting rights under a license.
Licensee	The party receiving defined rights under a license.

Appendix B. Suggested LMS Course Completion Checklist

- Course overview reviewed
- Lesson 1 completed

- Lesson 2 completed
- Lesson 3 completed
- Reflection questions completed
- Knowledge checks/quizzes completed
- Practical assignment submitted
- Feedback reviewed
- Final course reflection completed